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# THERMODYNAMIC AND RELATED PROPERTIES OF PARAHYDROGEN FROM THE TRIPLE POINT TO 300 K AT PRESSURES TO 1000 BAR

WEBER



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# THERMODYNAMIC AND RELATED PROPERTIES OF PARAHYDROGEN FROM THE TRIPLE POINT TO 300 K AT PRESSURES TO 1000 BAR

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# Thermodynamic and Related Properties of Parahydrogen from the Triple Point to 300 K at Pressures to 1000 Bar*

L. A. Weber

NBS compressibility measurements and thermodynamic properties data for parahydrogen have been extended to higher temperatures and pressures. Results of an experimental program are presented in the form of new PVT data in the temperature range 23-300 K at pressures up to 800 bar. Also given are tables of thermodynamic properties on isobars to 1000 bar including density, internal energy, enthalpy, entropy, specific heats at constant volume and constant pressure, velocity of sound, and the surface derivatives $(\partial P/\partial T)_V$ and $(\partial P/\partial \rho)_T$. The accuracy of the data is discussed and comparisons are made with previous data.

Key words: density, enthalpy, entropy, hydrogen, properties of fluids, specific heat, velocity of sound.

## 1. Introduction

Approximately ten years ago this laboratory published accurate measurements of the densities, compressibilities and thermodynamic properties of parahydrogen in the range from the triple point to 100 K at pressures up to 340 bar [1, 2]. That work was sponsored by NASA and it satisfied most of the requirements of the U.S. space program at that time for properties data on hydrogen. In recent years, however, new programs have resulted in the need for an accurate knowledge of the properties of hydrogen, and other fluids, over a much wider range of temperatures and pressures. An interim report [3] attempted to satisfy those needs by extrapolating the available data to higher pressures. We have now extended our previous PVT measurements to higher temperatures (300 K) and pressures (800 bar). This report presents the results of that experimental program. Approximately 374 PVT data points were measured.

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at 31 densities ranging from 10 to 44 mol/$\ell$. Experimental pressures ranged up to about 800 bar, and the tables of derived properties have been extrapolated to 1000 bar for the convenience of the user.

The data have been smoothed and represented analytically to allow calculation of the thermal properties. The results have been compared with the earlier NBS data and, above 100 K, with the data of Michels et al. [4].

## 2. Experimental Method

### 2.1 Description of the Apparatus

The apparatus originally designed and described by Goodwin [5] was used with some modifications. Only a brief description is given here. The sample holder consists of a heavy-walled copper container with a small cavity having a volume of about 27 $cm^3$. Temperatures are measured with a platinum resistance thermometer mounted in a well in the sample holder. The sample is introduced into the cavity via a stainless steel capillary having a diameter of about 0.033 cm. The sample holder is mounted in a nearly adiabatic cryostat, and the small amount of residual cooling is balanced by means of a temperature controller and a heater wrapped around the outside of the copper container. Pressure is measured by means of an oil-operated dead weight gage. The pressure measuring system was described in more detail by Weber [6]. The amount of sample is determined by releasing it into a set of four calibrated, thermostated glass bulbs having volumes from one to twenty liters. Pressure in the bulbs is measured by means of a quartz spiral bourdon gage. A more complete description of the apparatus in its present form has been given by Prydz and Straty [7] in their work on fluorine. The parts of the apparatus dealing with the problems of sample preparation and disposal, unique to fluorine, were dismantled for this work. The sample preparation system for the hydrogen samples consisted of a

Molecular sieve trap at 76 K to remove any water and an ortho-para conversion trap maintained at 20 K. The ortho-para composition was monitored by means of an analyzer operating on the principle of a thermal conductivity bridge. Samples were taken from cylinders of ultra high purity hydrogen.

The volume calibrations given in reference [7] for the various parts of the apparatus were used in this work with two exceptions. The differential pressure indicator, used to separate the hydrogen sample from the working fluid of the pressure measuring system, was replaced with one in which the parts in contact with the hydrogen were fabricated from A-286 steel. The volume of this device is an important factor in computing the density. It was redetermined by gas expansion into a calibrated glass bulb and found to be 0.59 $cm^3$. The other volume change was that of the sample holder itself. This container is made of electrolytic tough pitch copper, and its elastic limit was estimated by means of a model for thick-wall vessels to be in the neighborhood of 1000 bar. However, after it was pressurized to a maximum pressure of 850 bar its volume was found to have increased inelastically by 5.1%. This fact was determined by comparing the PVT data taken before and after the pressurization with the earlier results from the same apparatus in reference [1]. This pressure was never exceeded during the subsequent experimental work, and numerous similar comparisons confirmed the fact that the volume did not increase further. The volume of the sample holder at 293 K and a pressure of one bar used here is 27.199 $cm^3$. Suitable adjustments for changes in temperature and pressure were made as given in reference [7].

## 2.2 Experimental Procedure

In practice the sample, having passed through the preparation system, is loaded into the sample holder at some predetermined filling conditions and sealed off by means of a stainless steel valve mounted

on top of the cryostat. During this procedure some of the gas is bled off into the ortho-para analyzer. Pressure is measured as a function of temperature at discreet, integral temperatures along a path of nearly constant density. When the maximum temperature or pressure is reached, the sample is released into the glass bulbs. The bulbs are chosen in such a way that the final pressure is about one bar. Measurement of this pressure, coupled with the use of room temperature virial coefficients, which are generally known, allows the calculation of the amount of sample.

## 3. Experimental Results

### 3.1 The Data

Approximately 374 new data points were taken along 31 lines of constant density (isochores). Data on each isochore were measured on a set of predetermined temperatures so that the ultimate result would be a set of isotherms. Temperatures above 90 K were measured on the IPTS 1948 and, below 90 K, on the NBS 1955 temperature scales so that the results could be integrated with the earlier NBS data in reference [1]. For each experimental density one or more data points were measured within the range of the data of reference [1] in order to insure the continued compatibility of the two sets of data. The data are given in Table I and their location with respect to the earlier data is shown in Figure 1. Experimental temperatures on the IPTS 68 scale are also included in the table.

### 3.2 Representation of the Data

The combined sets of the present data and those from [1] were used in the formulation of the PVT surface. No attempt has been made to fit all the data to one wide-range equation of state. Instead the data were divided into three regions, by density, and each region was smoothed and interpolated by the means which seemed most appropriate. Location of the three regions is shown in Figure 2, and they are discussed separately below.

Low density region. In order to insure proper behavior of some of the thermodynamic properties, such as entropy, it is necessary to represent the low density region with an analytic surface having a virial-type expansion in density. A truncated virial expression with two coefficients,

$$P = RT\rho(1 + B\rho + C\rho^2) \qquad (1)$$

was found to represent the data with sufficient accuracy up to a density of 7 mol/l, or about one half critical density. The temperature dependence of the virial coefficients, B and C, is especially important due to the fact that the derived thermodynamic properties depend on the first and second temperature derivatives of these quantities. Thus the success of a given mathematical representation should be judged not only by how well the experimental densities are reproduced but also by how well any experimental thermodynamic properties can be reproduced. The latter criterion is much more stringent. The expressions for B and C in reference [2] were successfully used to calculate specific heats in agreement with experimental values at temperatures up to 100 K, and they are used here. For temperatures above 100 K we have data only for densities greater than about 10 mol/$\ell$. Therefore we were forced to look elsewhere for virial coefficients. The correlation by Goodwin et al. [8] gives expressions for B and C from 15 to 423 K. These appear to have the proper behavior in the region of interest here and they were incorporated into the PVT surface for the range 100 to 300 K. A complete description of the functions and parameters used for B and C is given in Appendix A.

Intermediate densities. The data in this region are represented by 58 isotherm polynomials of the form

$$P = RT\rho + \sum_{J=1}^{N} A_J \rho^{(J+1)} . \qquad (2)$$

The number of coefficients varied from a maximum of 15 for the 33 K isotherm to a minimum of 3. These isotherms fit the data with standard deviations of 0.01-0.03% in density. The isotherms were used to interpolate the data to even increments in density. The pressure-temperature pairs thus obtained for a given density were fit with an isochore polynomial of the form,

$$P = \sum_{J=1}^{5} A_J T^{(3-J)} . \qquad (3)$$

A total of 68 isochore polynomials were used between 6.5 and 40 mol/$\ell$, with a 0.5 mol/$\ell$ increment in density. The parameters used in equations (2) and (3) are given in Tables II and III respectively.

High densities. The high density compressed liquid data, bounded by the melting curve and the 38 mol/$\ell$ isochore, were represented by means of a fourteen parameter empirical surface given by

$$P = RT\rho + (A_1T^2+A_2T+A_3+A_4/T) + (A_5T^2+A_6T+A_7+A_8/T+A_9/T^2)\rho$$

$$+ (A_{10}T^2+A_{11}T+A_{12})\rho^2+ (A_{13}T^2 + A_{14}T)\rho^3 . \qquad (4)$$

The values of the parameters are given in Table IV. The surface was constrained to the triple point given in [2]. Standard deviation for the fit of this surface was 0.014% in density, and it was used for representing the PVT surface at densities greater than 40 mol/$\ell$.

Other data. The critical parameters, melting pressures, liquid-vapor two phase boundary, and vapor pressure curve were all taken from [2]. and they are repeated in Appendix B for the convenience of the reader.

Interpolation methods for densities. Equations (1-4) are all explicit in pressure. Therefore the density at a given temperature and

pressure must be found by iteration. In the low and high density regions a simple Newton's iteration was used along an isotherm of the analytic surfaces (1) or (4). In the intermediate density region densities were found by a linear interpolation between the isochores tabulated in Table III.

3.3 Estimate of Uncertainty of the PVT Data

Based upon a consideration of the uncertainties in the calibration procedure and upon the results of several workers over a period of years, the volume of the sample holder is believed to be known to within 0.1%. The uncertainty in the room temperature volumes connected to the sample holder is about 0.02 $cm^3$. Thus the maximum uncertainty from these two sources varies from 0.1% for a low temperature compressed liquid to 0.17% for the room temperature gas data. Corrections were made for the temperature variation of the sample holder volume using well known thermal expansion data for copper. Uncertainties due to this source are estimated to be of the order of 0.01%. Corrections for the volume change with pressure were also made using the Young's modulus for copper and a relationship applicable to thick-wall containers. The remaining uncertainty is probably of the order of several hundredths of one percent at the highest pressures. The accuracy of the pressure gage is claimed to be 0.01%. Corrections were made for the hydrostatic pressure heads in the apparatus connected to the sample holder during measurements. Errors due to this source are considered negligible. Temperatures were measured and reproduced to within about 0.001 K. Overall accuracy of the potentiometric measurement of the absolute temperature is less, however, and varies from 0.002 K at 50 K to 0.028 K at room temperature. The above uncertainties are systematic and the total is seen to vary from a minimum of about 0.1% for the low pressure compressed liquid to about 0.2% for the high

pressure room temperature gas data. The experimental precision is about 0.02% in density.

The above uncertainties apply to the experimental data. It is inevitable that the interpolation functions used to calculate the final tables will degrade the accuracy somewhat. This effect may be seen by using the experimental data as input test points for the computer program which is used to calculate the smoothed tables. When this is done the standard deviation of all the data from the calculated surface is 0.04% in density. The deviation of the individual points is given in the last column in Table I.

3.4 Comparisons with Previous Data

The present data have been compared to the earlier data of [1] and [4] via the surface representation in reference [3], which was fit to the data of [1] below 90 K and to the data of [4] above 100 K. The average deviation of the new data from the earlier NBS data of [1] is 0.021% in density based on a comparison of 37 data points. Reference [3] also included an extrapolation of the data of [1] up to a pressure of 10,000 psia (689 bar). Figure 3 is a comparison of that extrapolation with the present data at three temperatures. It is seen that the differences approach one percent in density at the highest pressures. The apparent scatter shown in the figure is mostly in the calculated extrapolation rather than the experimental data.

Comparison with the work of Michels et al., [4], is more complex as the differences exhibit systematic trends with both temperature and density. A comparison at three temperatures is given in Figure 4. Deviations are seen to be as large as 0.25%. The data of Michels et al. were measured on normal hydrogen while our data are for parahydrogen. It has not been determined whether the above differences

could be due to the different compositions. As part of the preliminary work for this project some PVT measurements were made at lower temperatures on hydrogen of approximately normal composition. Those results along with some earlier measurements, [5, 9], are compared with the parahydrogen PVT surface in Figure 5. Although the three sets of data shown are not completely consistent, the figure suggests that while the difference between the densities of liquid normal and parahydrogen is large, at higher temperatures it should be less than 0.1%. The present results are based entirely on parahydrogen data.

3.5 Thermodynamic Properties.

Accurate representation of precise PVT data allows calculation of the equilibrium thermodynamic properties by means of the appropriate thermodynamic relationships. These relationships and calculation techniques have been given in reference [2] and elsewhere, and they will not be repeated here. Only the change of each property with density at constant temperature is calculated, and to this must be added the ideal gas value at that temperature. The thermodynamic properties of the ideal gas used here are the same as used in reference [3], which were originally taken from the work of Woolley, Scott, and Brickwedde [10]. The results are tabulated for the liquid-vapor coexistence boundary in Table V and along isobars from 1-1000 bar in Table VI. For the low and high density regions, described by equations (1) and (4), thermodynamic properties such as enthalpy could be calculated explicitly as functions of density and temperature. For the intermediate densities, however, there are no closed form calculations, and numerical integrations were used to calculate the derived properties. The tables use the gram as the unit of mass, and the molecular weight was taken to be 2.01572.

A rigorous calculation of the uncertainties in the derived properties is generally not possible. Comparison with experimentally measured values is to be preferred when the latter are available. Often

it is necessary to rely on the estimate of the author and on comparisons of values calculated from the data of different laboratories. In reference [2] calculated and experimental values of $C_v$ were found to agree to within 1%. A similar comparison with experimental velocity of sound values showed agreement to within 0.5%. In the broader range of temperature and pressure considered here, where no experimental data exist for $C_v$ or velocity of sound, we may expect the calculated values to have about the same accuracy. We may arrive at the same estimate by considering the thermodynamic relationship used to calculate $C_v$. The contribution of the PVT surface to the specific heat depends on the second derivative of the PVT surface in the integral $\int (\partial^2 P/\partial T^2)_v \, d\rho/\rho^2$. The precision of the experimental data leads us to believe that we can calculate this isochore second derivative with an accuracy of about 10%. However, except in the critical region, this contribution amounts to only about 10% of the total specific heat. The uncertainty in the 90% contribution from the ideal gas is negligible for simple molecules. The specific heat at constant pressure, $C_P$, is derived from $C_v$ by means of first derivatives of the PVT surface, $(\partial P/\partial T)_v$ and $(\partial P/\partial \rho)_T$, which are tabulated in Tables V and VI. The uncertainties in these quantities are of the order of 1%, leading to a similar uncertainty in $C_P$.

The uncertainty in the tabulated values for enthalpy and entropy may be estimated in similar fashion. For example, enthalpy is obtained via the relation,

$$H(T,\rho) = H^o(T) + P/\rho - RT + \int_o^\rho \left[P - T\left(\frac{\partial P}{\partial T}\right)_\rho\right] \frac{d\rho}{\rho^2}, \quad (5)$$

where $H^o$ refers to the ideal gas. The integrand in equation (5) vanishes for an ideal gas and for a real gas such as hydrogen at room temperature it becomes a small difference between two large quantities. Fortunately in such cases where the relative uncertainty is large, this term makes

only a small contribution to the calculated enthalpy. By the use of such arguments we may say that we expect the tabulated enthalpy to have an uncertainty which varies from zero at the low density limit to a maximum of about 10 J/mol for the liquid and the high pressure gas. This uncertainty would also apply to the internal energy. Uncertainty in the entropy varies from zero to about 0.05 J/mol-K for the compressed gas and about 0.1 J/mol-K for the liquid. Uncertainties for all properties are larger in the critical region.

A comparison between the tabulated enthalpies and those calculated by Michels et al. [4] is given in Figure 6. It is seen that the difference between the two calculations reaches a maximum of 27 J/mol at room temperature. The density differences in this region, shown in Figure 4, would account for about 3 J/mol. Comparison was also made with the recent direct enthalpy measurements of Dawe and Snowdon [11], which were performed on normal hydrogen at pressures up to 100 bar (densities up to about 5 mol/$\ell$) along five isotherms between 222 and 367 K. Their results agree very well with our calculations and with those of Michels et al. in this low density range.

## 4. Acknowledgments

The author is indebted to D. E. Diller and G. C. Straty for many helpful discussions and to R. D. McCarty for the least-squares program used here. This work was supported by NASA Contract C-32369-C.

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## Appendix A. Interpolation Functions and Parameters Defining the Second and Third Virial Coefficients

B is in $cm^3/mol$, C in $(cm^3/mol)^2$.

(a) Second virial coefficient.

For temperatures less than 100 K [2]:

$$RTB = A_1 T + A_2 + A_3/T + A_4/T^2 \qquad (1a)$$

with

$$A_1 = 1.939\ 7741 \times 10^3$$

$$A_2 = -1.927\ 9522 \times 10^5$$

$$A_3 = -2.289\ 0051 \times 10^6$$

$$A_4 = 1.109\ 4088 \times 10^7$$

Temperatures greater than 100 K [8]:

$$B = B_1 x^{1/4} + B_2 x^{3/4} + B_3 x^{5/4} + B_4 x^{7/4} \qquad (2a)$$

where $x = 109.781/T$ and

$$B_1 = 42.464$$

$$B_2 = -37.1172$$

$$B_3 = -2.2982$$

$$B_4 = -3.0484$$

(b) Third virial coefficient.

Temperatures less than 55 K [2]:

$$RTC = C_1T^2 + C_2T + C_3 + C_4/T + C_5/T^2 + C_6/T^3 \qquad (1b)$$

Two sets of parameters were used

| | $T<T_c$ | $T_c<T<55$ |
|---|---|---|
| $C_1$ | $1.054\ 1776 \times 10^5$ | $1.697\ 1294 \times 10^3$ |
| $C_2$ | $-1.659\ 7141 \times 10^7$ | $-5.085\ 4223 \times 10^5$ |
| $C_3$ | $1.043\ 1411 \times 10^9$ | $6.728\ 4118 \times 10^7$ |
| $C_4$ | $-3.253\ 8718 \times 10^{10}$ | $-3.804\ 5171 \times 10^9$ |
| $C_5$ | $5.140\ 5848 \times 10^{11}$ | $1.078\ 9413 \times 10^{11}$ |
| $C_6$ | $-3.312\ 3453 \times 10^{12}$ | $-1.151\ 5642 \times 10^{12}$ |

Temperatures between 55 and 100 K [2]:

$$RTC = RTC_1 e^{C_2/T} \left\{ 1 - e^{C_3 \left[ 1 - (T/C_4)^{C_5} \right]} \right\} \qquad (2b)$$

with

$$C_1 = 388.682$$

$$C_2 = 45.5$$

$$C_3 = 0.60$$

$$C_4 = 20.0$$

$$C_5 = 4.0$$

For temperatures greater than 100 K [8]:

$$C = C_1 x^{1/2} \left[1 + C_2 x^3\right] \left[1 - e^{(1 - x^{-3})}\right] \qquad (3b)$$

with

$$x = 20.615/T$$

$$C_1 = 1310.5$$

$$C_2 = 2.1486$$

## Appendix B. Fixed Points and Phase Equilibrium Boundaries Used for parahydrogen, taken from reference [2]

(a) **Triple point:**

$$P_t = 0.0704 \text{ bar}$$

$$T_t = 13.803 \text{ K}$$

$$\rho_t \text{ (liquid)} = 38.21 \text{ mol}/\ell$$

(b) **Normal boiling point:**

$$P_b = 1.01325 \text{ bar}$$

$$T_b = 20.268 \text{ K}$$

$$\rho_b \text{ (liquid)} = 35.11 \text{ mol}/\ell$$

$$\rho_b \text{ (gas)} = 0.6636 \text{ mol}/\ell$$

(c) **Critical point:**

$$P_c = 12.928 \text{ bar}$$

$$T_c = 32.976 \text{ K}$$

$$\rho_c = 15.59 \text{ mol}/\ell$$

Note: More recent data indicate that the true critical temperature is probably closer to 32.93 K. See ref. [12]. However, that value was not used here pending further verification.

(d) **Melting pressures:** in atmospheres

$$P = P_t + (T - T_t)\left[A_1 e^{-\alpha/T} + A_2 T\right]$$

$$A_1 = 30.3312$$

$$A_2 = 0.6667$$

$$\alpha = 5.693$$

(e) Liquid-vapor coexistence densities:

liquid, density in $mol/cm^3$,

$$\rho \text{ sat } \ell = \rho_c + A_1 (\Delta T)^{0.380} + A_2 (\Delta T) + A_3 (\Delta T)^{4/3} + A_4 (\Delta T)^{5/3} + A_5 (\Delta T)^2$$

$$A_1 = 7.323\ 4603 \times 10^{-3}$$

$$A_2 = -4.407\ 4261 \times 10^{-4}$$

$$A_3 = 6.620\ 7946 \times 10^{-4}$$

$$A_4 = -2.922\ 6363 \times 10^{-4}$$

$$A_5 = 4.008\ 4907 \times 10^{-5}$$

$$\Delta T = T_c - T$$

vapor $T_b \leq T \leq T_c$, density in $mol/cm^3$

$$\rho \text{ sat } G = \rho_c + A_1 (\Delta T)^{0.370} + A_2 (\Delta T) + A_3 (\Delta T)^{0.7} + A_4 (\Delta T)^{0.8}$$

$$A_1 = -7.196\ 7724 \times 10^{-3}$$

$$A_2 = 1.449\ 5527 \times 10^{-3}$$

$$A_3 = 3.240\ 3120 \times 10^{-3}$$

$$A_4 = -4.464\ 0177 \times 10^{-3}$$

Saturated vapor densities for temperatures below the normal boiling point are calculated using equation (1) in the text and the vapor pressure equation below:

(f) Vapor pressure: in atmospheres, for $T \leq 29$ K,

$$\log_{10} P_a = A_1 + \frac{A_2}{T + A_3} + A_4 T$$

$$A_1 = 2.000\ 620$$

$$A_2 = -50.09\ 708$$

$$A_3 = 1.0044$$

$$A_4 = 1.748\ 495 \times 10^{-2}$$

for $T > 29$K,

$$P = P_a + A_5 (T - 29)^3 + A_6 (T - 29)^5 + A_7 (T-29)^7$$

$$A_5 = 1.317 \times 10^{-3}$$

$$A_6 = -5.926 \times 10^{-5}$$

$$A_7 = 3.913 \times 10^{-6}$$

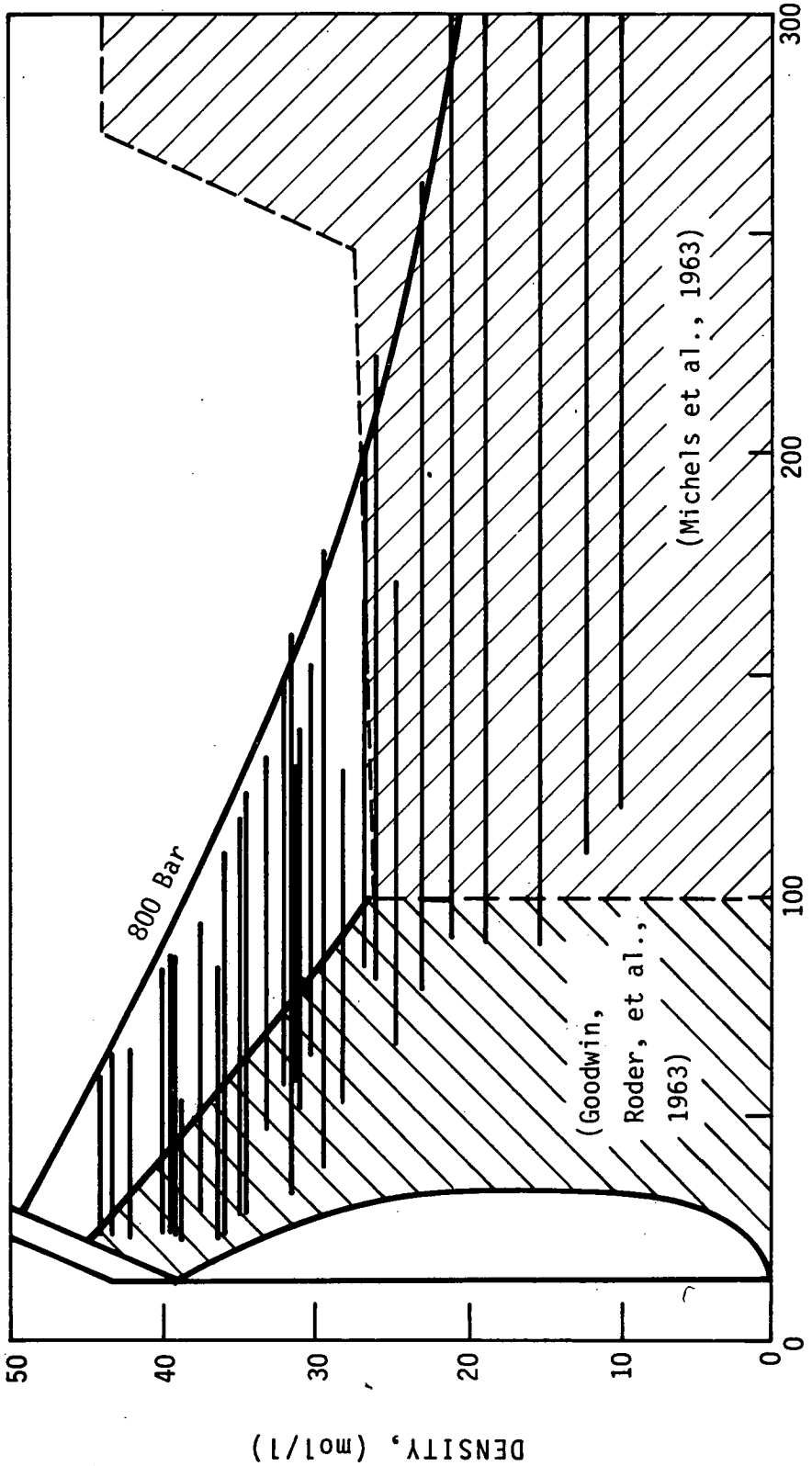


Figure 1. Density-temperature diagram showing location of the new data as well as the earlier data.

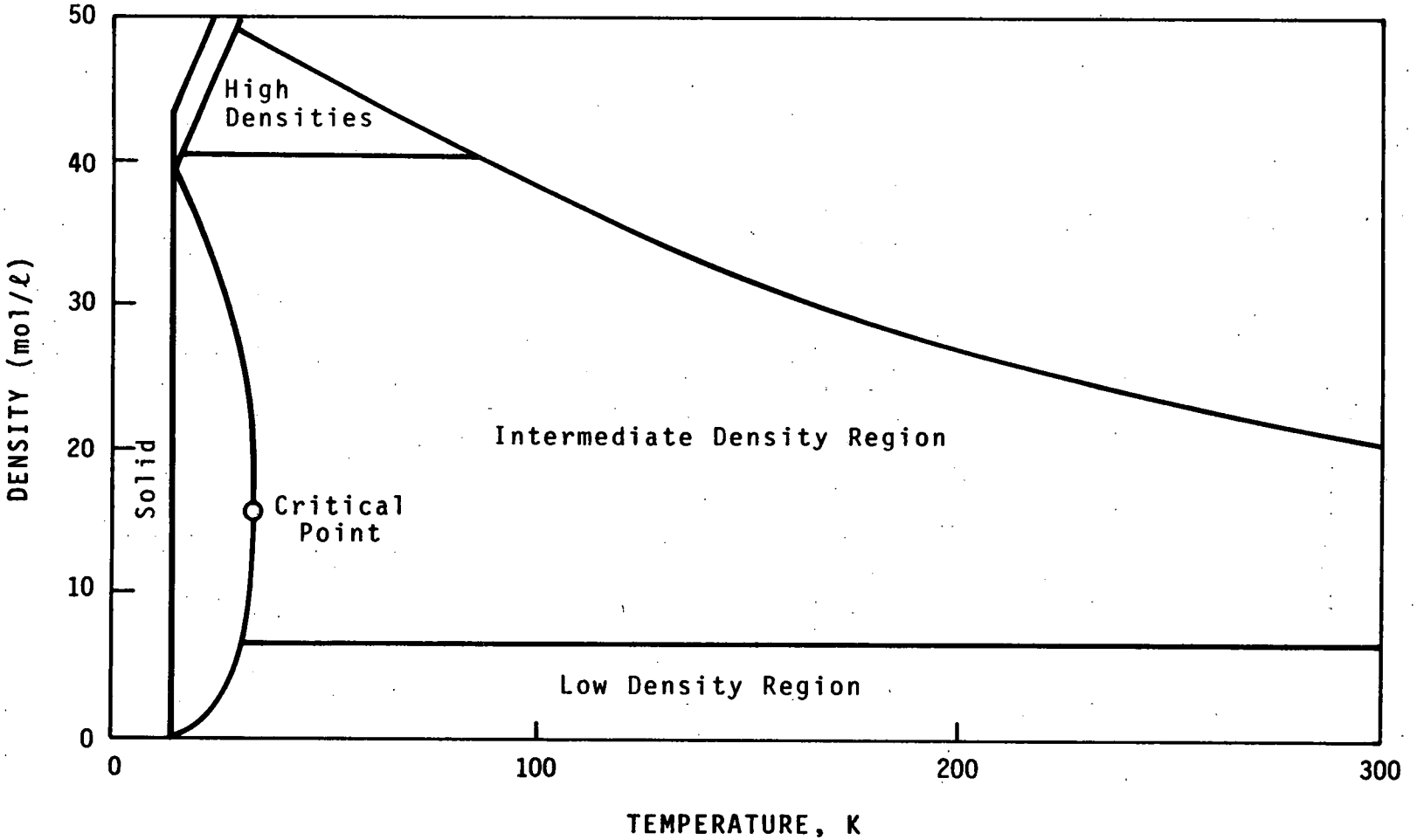


Figure 2. Density-temperature diagram showing the three regions used for the representation of the data.

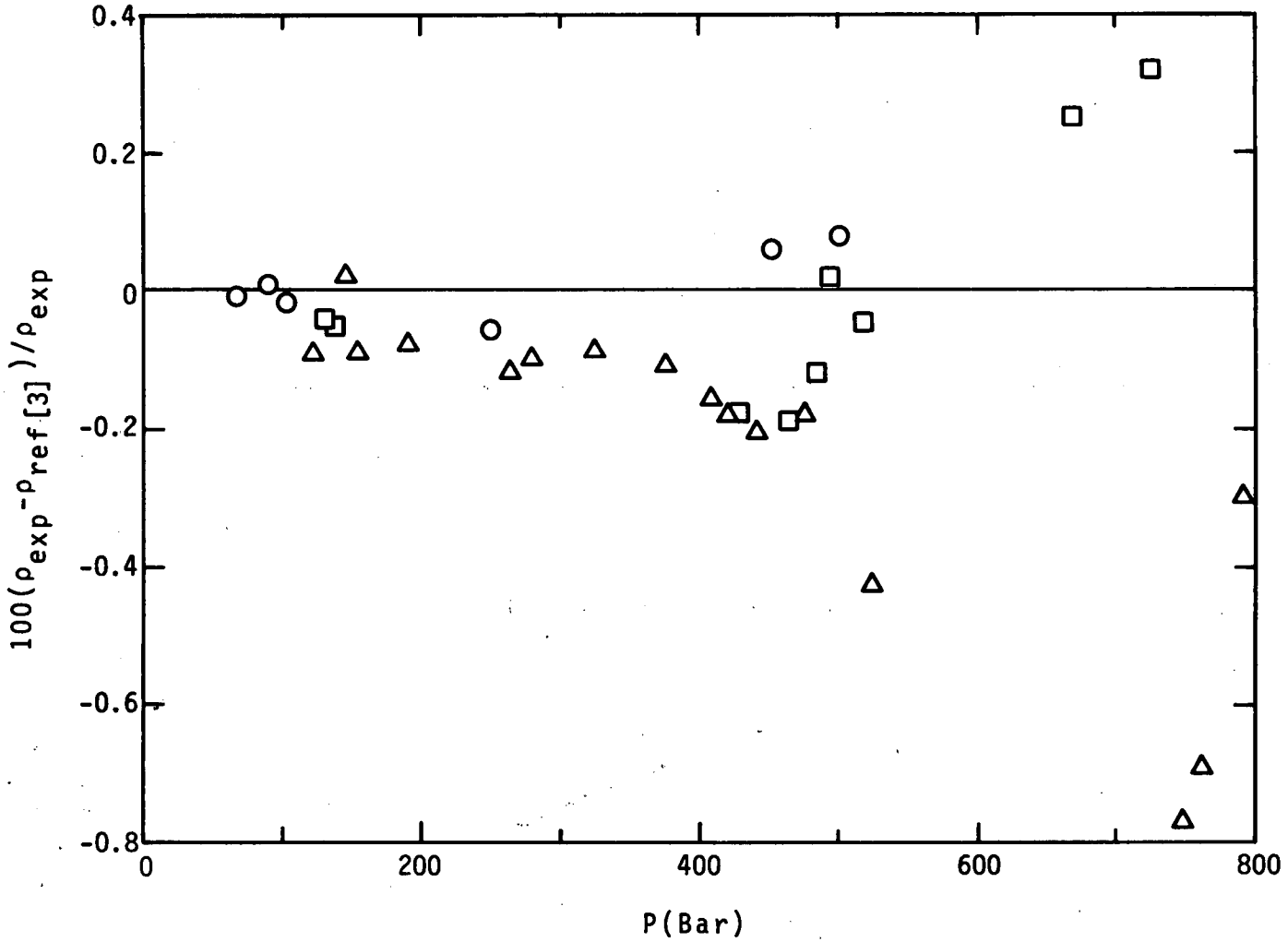


Figure 3. Comparison of data with the surface given in ref. [3]; 0-40 K, □-60 K, Δ-90 K.

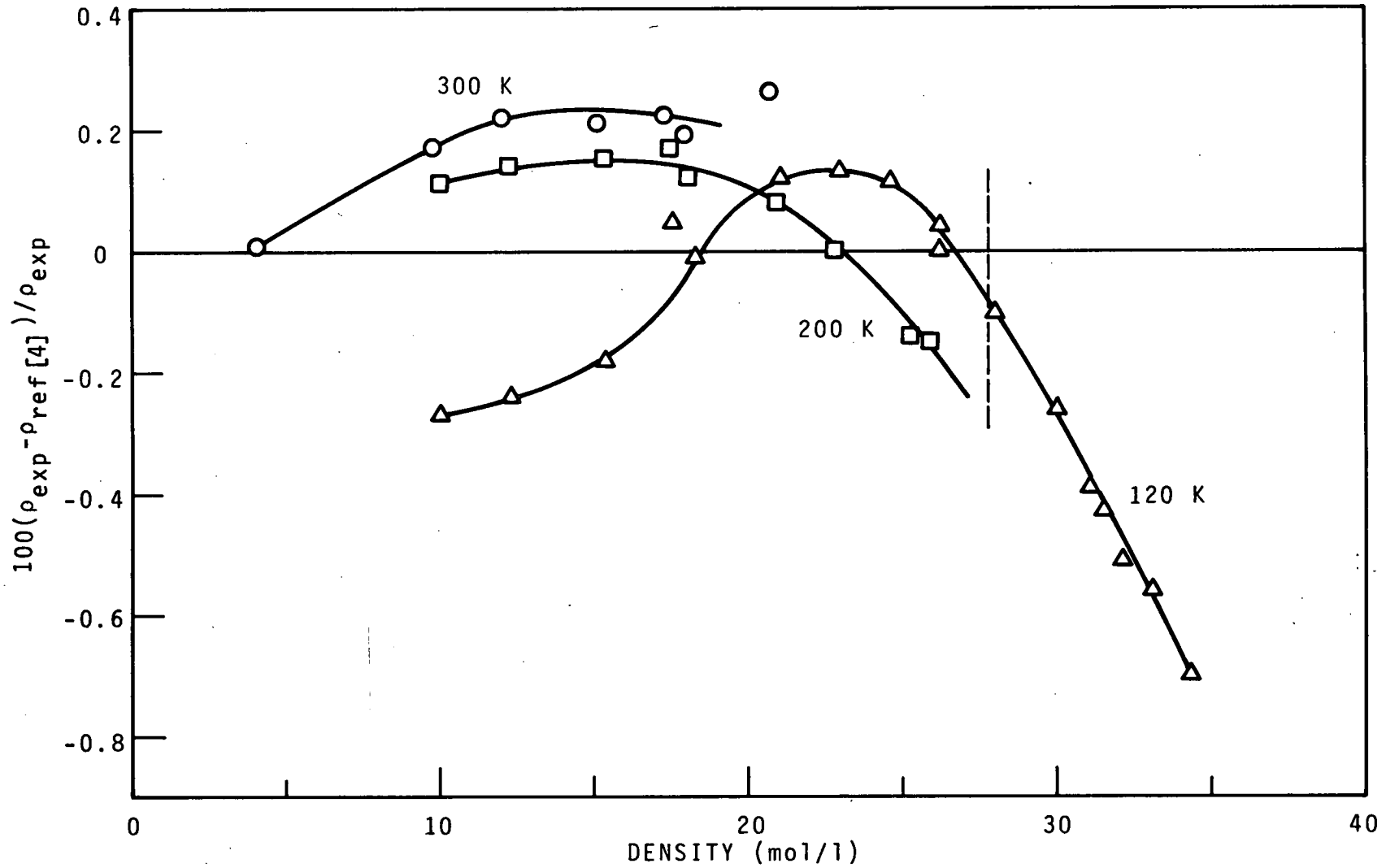


Figure 4. Comparison with the data of Michels et al. [4] as represented by the surface given in ref. [3]; Δ -120 K, -200 K, 0-300 K. The dashed line indicates the upper limit of the data of [4] beyond which the surface was extrapolated.

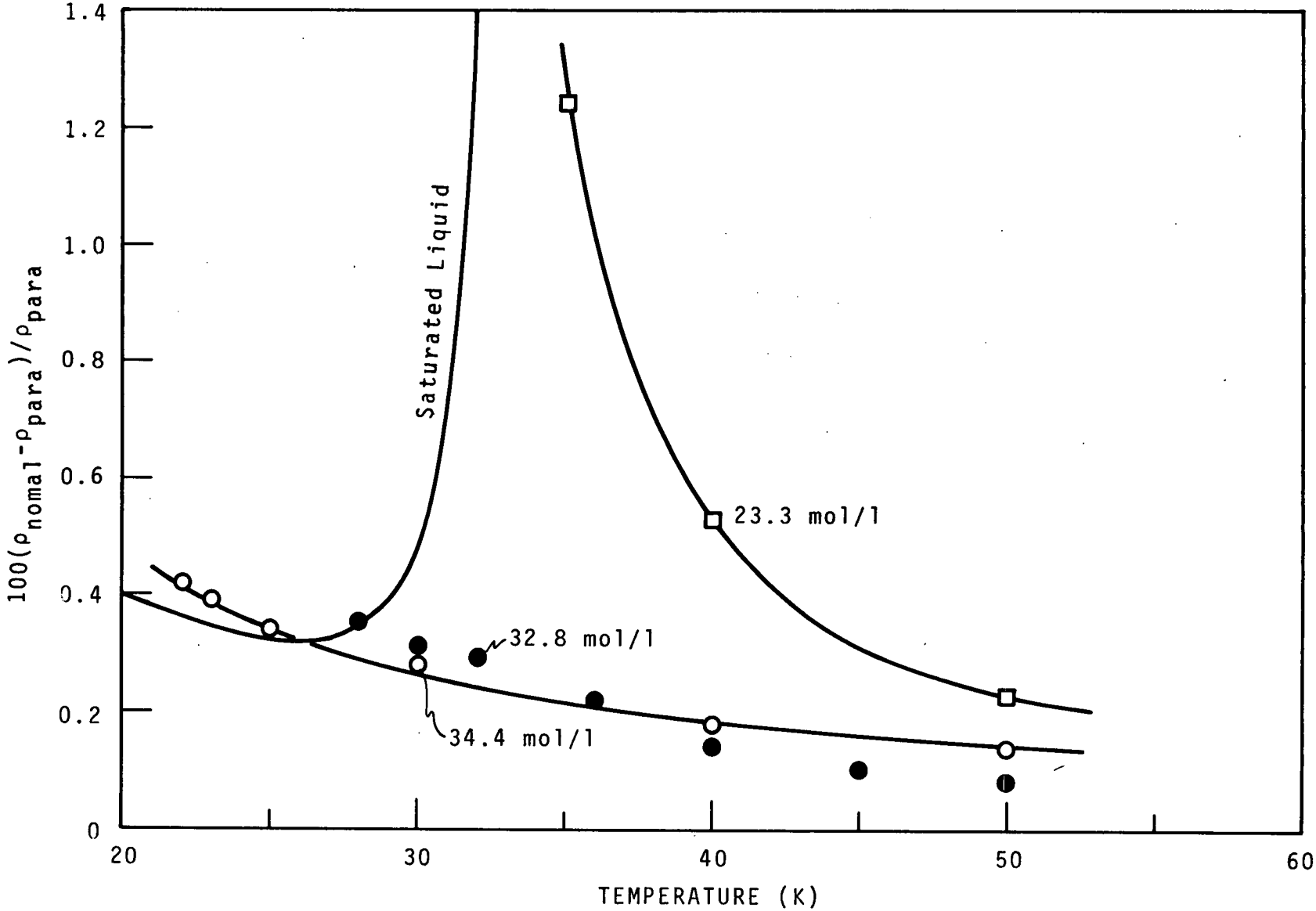


Figure 5. Density differences between normal and parahydrogen at a given temperature and pressure.

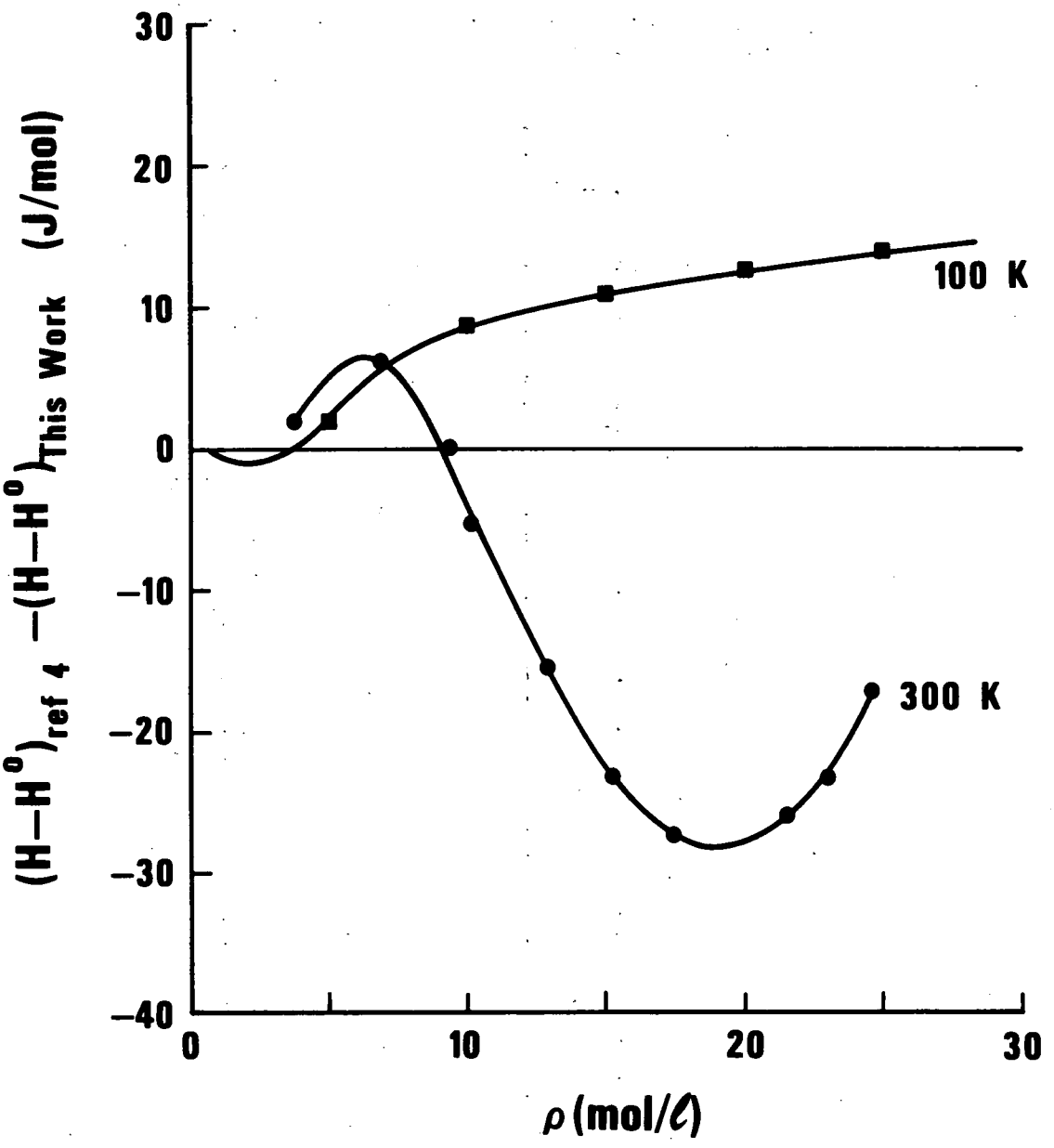


Figure 6. Comparison of enthalpy with values calculated by Michels et al. [4].

TABLE I. EXPERIMENTAL PVT DATA FOR PARAHYDROGEN.

| IDENT | T K | T1968 K | PRESSURE BAR | DENSITY MOL/L EXP | DENSITY MOL/L CALC | DIFFERENCE PERCENT |
|---|---|---|---|---|---|---|
| 101 | 30 | 30.008 | 123.895 | 36.994 | 37.003 | 0.02 |
| 103 | 60 | 59.999 | 385.529 | 36.767 | 36.778 | 0.03 |
| 104 | 65 | 65.000 | 426.996 | 36.735 | 36.744 | 0.02 |
| 105 | 70 | 70.000 | 467.841 | 36.705 | 36.709 | 0.01 |
| 106 | 75 | 74.994 | 508.000 | 36.677 | 36.673 | -0.01 |
| 107 | 80 | 79.991 | 547.680 | 36.649 | 36.640 | -0.02 |
| 108 | 85 | 84.997 | 586.809 | 36.622 | 36.608 | -0.04 |
| 109 | 90 | 90.010 | 625.490 | 36.596 | 36.580 | -0.04 |
| 201 | 35 | 35.011 | 116.484 | 34.665 | 34.678 | 0.04 |
| 202 | 75 | 74.994 | 419.581 | 34.403 | 34.413 | 0.03 |
| 203 | 80 | 79.991 | 454.949 | 34.376 | 34.380 | 0.01 |
| 204 | 85 | 84.997 | 489.906 | 34.350 | 34.349 | -0.00 |
| 205 | 90 | 90.010 | 524.430 | 34.325 | 34.319 | -0.02 |
| 206 | 95 | 95.013 | 558.809 | 34.301 | 34.297 | -0.01 |
| 207 | 100 | 100.010 | 592.528 | 34.278 | 34.270 | -0.02 |
| 208 | 110 | 109.998 | 658.702 | 34.230 | 34.218 | -0.03 |
| 209 | 120 | 119.989 | 723.294 | 34.187 | 34.171 | -0.05 |
| 210 | 130 | 129.987 | 786.512 | 34.145 | 34.128 | -0.05 |
| 301 | 30 | 30.008 | 107.368 | 36.300 | 36.302 | 0.01 |
| 302 | 60 | 59.999 | 360.675 | 36.075 | 36.086 | 0.03 |
| 303 | 65 | 65.000 | 400.773 | 36.044 | 36.052 | 0.02 |
| 304 | 70 | 70.000 | 440.262 | 36.014 | 36.018 | 0.01 |
| 305 | 75 | 74.994 | 479.182 | 35.986 | 35.985 | -0.00 |
| 306 | 80 | 79.991 | 517.482 | 35.959 | 35.951 | -0.02 |
| 307 | 85 | 84.997 | 555.369 | 35.932 | 35.921 | -0.03 |
| 308 | 90 | 90.010 | 592.845 | 35.907 | 35.894 | -0.04 |
| 309 | 95 | 95.013 | 629.738 | 35.882 | 35.865 | -0.05 |
| 310 | 100 | 100.010 | 666.148 | 35.858 | 35.838 | -0.06 |
| 311 | 110 | 109.998 | 737.598 | 35.809 | 35.787 | -0.06 |
| 401 | 30 | 30.008 | 40.992 | 32.212 | 32.207 | -0.02 |
| 402 | 80 | 79.991 | 372.324 | 31.906 | 31.909 | 0.01 |
| 403 | 85 | 84.997 | 403.043 | 31.882 | 31.881 | -0.00 |
| 404 | 90 | 90.010 | 433.419 | 31.858 | 31.856 | -0.01 |
| 405 | 95 | 95.013 | 463.405 | 31.836 | 31.830 | -0.02 |
| 406 | 100 | 100.010 | 492.849 | 31.813 | 31.799 | -0.04 |
| 407 | 110 | 109.998 | 551.127 | 31.767 | 31.751 | -0.05 |
| 408 | 120 | 119.989 | 608.200 | 31.727 | 31.708 | -0.06 |
| 409 | 130 | 129.987 | 664.244 | 31.688 | 31.671 | -0.05 |
| 410 | 140 | 139.992 | 719.257 | 31.651 | 31.642 | -0.03 |
| 411 | 150 | 150.000 | 773.207 | 31.614 | 31.614 | -0.00 |
| 412 | 160 | 160.010 | 825.783 | 31.578 | 31.577 | -0.00 |

TABLE I. EXPERIMENTAL PVT DATA FOR PARAHYDROGEN.

| IDENT | T K | T1968 K | PRESSURE BAR | DENSITY MOL/L EXP | DENSITY MOL/L CALC | DIFFERENCE PERCENT |
|---|---|---|---|---|---|---|
| 501 | 40 | 40.015 | 82.956 | 29.917 | 29.921 | 0.01 |
| 502 | 90 | 90.010 | 366.450 | 29.659 | 29.675 | 0.06 |
| 503 | 95 | 95.013 | 392.967 | 29.638 | 29.652 | 0.05 |
| 504 | 100 | 100.010 | 419.152 | 29.617 | 29.626 | 0.03 |
| 505 | 110 | 109.998 | 470.697 | 29.575 | 29.575 | 0.00 |
| 506 | 120 | 119.989 | 521.223 | 29.536 | 29.527 | -0.03 |
| 507 | 130 | 129.987 | 570.855 | 29.500 | 29.483 | -0.06 |
| 508 | 140 | 139.992 | 619.731 | 29.464 | 29.442 | -0.07 |
| 509 | 150 | 150.000 | 667.783 | 29.429 | 29.404 | -0.08 |
| 510 | 160 | 160.010 | 715.114 | 29.396 | 29.369 | -0.09 |
| 511 | 170 | 170.019 | 761.553 | 29.363 | 29.332 | -0.10 |
| 512 | 180 | 180.027 | 807.236 | 29.330 | 29.298 | -0.11 |
| 601 | 80 | 79.991 | 241.430 | 26.408 | 26.412 | 0.01 |
| 602 | 120 | 119.989 | 413.023 | 26.254 | 26.257 | 0.01 |
| 603 | 140 | 139.992 | 494.456 | 26.186 | 26.177 | -0.03 |
| 604 | 160 | 160.010 | 573.555 | 26.121 | 26.103 | -0.07 |
| 605 | 180 | 180.027 | 650.750 | 26.058 | 26.040 | -0.07 |
| 701 | 28 | 28.007 | 204.566 | 40.265 | 40.271 | 0.01 |
| 702 | 44 | 44.015 | 367.958 | 40.121 | 40.136 | 0.04 |
| 703 | 46 | 46.015 | 388.035 | 40.105 | 40.118 | 0.03 |
| 704 | 48 | 48.014 | 407.974 | 40.089 | 40.099 | 0.03 |
| 705 | 50 | 50.013 | 427.847 | 40.074 | 40.082 | 0.02 |
| 706 | 55 | 55.007 | 477.063 | 40.036 | 40.039 | 0.01 |
| 707 | 60 | 59.999 | 525.557 | 40.001 | 39.999 | -0.01 |
| 708 | 65 | 65.000 | 573.466 | 39.967 | 39.973 | 0.01 |
| 709 | 70 | 70.000 | 620.656 | 39.934 | 39.937 | 0.01 |
| 710 | 75 | 74.994 | 667.092 | 39.903 | 39.901 | -0.00 |
| 711 | 80 | 79.991 | 712.839 | 39.873 | 39.867 | -0.02 |
| 712 | 85 | 84.997 | 758.108 | 39.844 | 39.837 | -0.02 |
| 713 | 90 | 90.010 | 802.792 | 39.816 | 39.812 | -0.01 |
| 801 | 28 | 28.007 | 186.982 | 39.781 | 39.785 | 0.01 |
| 802 | 44 | 44.015 | 347.318 | 39.637 | 39.652 | 0.04 |
| 803 | 46 | 46.015 | 366.981 | 39.620 | 39.635 | 0.04 |
| 804 | 48 | 48.014 | 386.541 | 39.605 | 39.619 | 0.04 |
| 805 | 50 | 50.013 | 406.032 | 39.589 | 39.603 | 0.04 |
| 806 | 55 | 55.007 | 454.141 | 39.553 | 39.561 | 0.02 |
| 807 | 60 | 59.999 | 501.635 | 39.517 | 39.521 | 0.01 |
| 808 | 65 | 65.000 | 548.547 | 39.483 | 39.483 | -0.00 |
| 809 | 70 | 70.000 | 594.701 | 39.451 | 39.445 | -0.01 |
| 810 | 75 | 74.994 | 640.100 | 39.420 | 39.408 | -0.03 |
| 811 | 80 | 79.991 | 684.951 | 39.391 | 39.374 | -0.04 |
| 812 | 85 | 84.997 | 729.251 | 39.362 | 39.344 | -0.05 |
| 813 | 90 | 90.010 | 773.070 | 39.334 | 39.319 | -0.04 |
| 814 | 95 | 95.013 | 816.135 | 39.307 | 39.295 | -0.03 |

TABLE I. EXPERIMENTAL PVT DATA FOR PARAHYDROGEN.

| IDENT | T K | T1968 K | PRESSURE BAR | DENSITY MOL/L EXP | DENSITY MOL/L CALC | DIFFERENCE PERCENT |
|---|---|---|---|---|---|---|
| 901 | 30 | 30.008 | 198.656 | 39.526 | 39.526 | 0.00 |
| 902 | 48 | 48.014 | 376.428 | 39.370 | 39.381 | 0.03 |
| 903 | 50 | 50.013 | 395.783 | 39.355 | 39.366 | 0.03 |
| 904 | 55 | 55.007 | 443.515 | 39.317 | 39.326 | 0.02 |
| 905 | 60 | 59.999 | 490.594 | 39.282 | 39.287 | 0.01 |
| 906 | 65 | 65.000 | 537.024 | 39.248 | 39.249 | 0.00 |
| 907 | 70 | 70.000 | 582.834 | 39.216 | 39.214 | -0.00 |
| 908 | 75 | 74.994 | 627.959 | 39.185 | 39.178 | -0.02 |
| 909 | 80 | 79.991 | 672.326 | 39.155 | 39.144 | -0.03 |
| 910 | 85 | 84.997 | 716.248 | 39.126 | 39.115 | -0.03 |
| 911 | 90 | 90.010 | 759.688 | 39.099 | 39.092 | -0.02 |
| 912 | 95 | 95.013 | 802.405 | 39.072 | 39.071 | -0.00 |
| 1001 | 24 | 24.008 | 125.289 | 39.166 | 39.157 | -0.02 |
| 1002 | 26 | 26.007 | 145.004 | 39.146 | 39.141 | -0.01 |
| 1003 | 30 | 30.008 | 184.472 | 39.107 | 39.108 | 0.00 |
| 1004 | 34 | 34.010 | 223.862 | 39.069 | 39.076 | 0.02 |
| 1005 | 50 | 50.013 | 378.367 | 38.936 | 38.951 | 0.04 |
| 1006 | 55 | 55.007 | 425.284 | 38.899 | 38.911 | 0.03 |
| 1007 | 60 | 59.999 | 471.557 | 38.864 | 38.872 | 0.02 |
| 1101 | 32 | 32.008 | 95.319 | 34.871 | 34.868 | -0.01 |
| 1102 | 50 | 50.013 | 238.891 | 34.727 | 34.745 | 0.05 |
| 1103 | 70 | 70.000 | 389.473 | 34.597 | 34.618 | 0.06 |
| 1104 | 75 | 74.994 | 425.712 | 34.568 | 34.586 | 0.05 |
| 1105 | 85 | 84.997 | 496.795 | 34.513 | 34.524 | 0.03 |
| 1106 | 90 | 90.010 | 531.718 | 34.487 | 34.497 | 0.03 |
| 1107 | 95 | 95.013 | 566.091 | 34.462 | 34.468 | 0.02 |
| 1108 | 100 | 100.010 | 600.086 | 34.437 | 34.440 | 0.01 |
| 1109 | 110 | 109.998 | 666.875 | 34.390 | 34.390 | -0.00 |
| 1110 | 120 | 119.989 | 732.188 | 34.345 | 34.345 | 0.00 |
| 1201 | 50 | 50.013 | 89.657 | 24.862 | 24.865 | 0.01 |
| 1202 | 60 | 59.999 | 131.441 | 24.817 | 24.823 | 0.02 |
| 1203 | 100 | 100.010 | 291.109 | 24.660 | 24.681 | 0.08 |
| 1204 | 110 | 109.998 | 329.195 | 24.625 | 24.640 | 0.06 |
| 1205 | 120 | 119.989 | 366.654 | 24.592 | 24.598 | 0.03 |
| 1206 | 130 | 129.987 | 403.570 | 24.560 | 24.560 | -0.00 |
| 1207 | 150 | 150.000 | 475.892 | 24.497 | 24.488 | -0.04 |
| 1208 | 170 | 170.019 | 546.394 | 24.437 | 24.422 | -0.06 |

TABLE I. EXPERIMENTAL PVT DATA FOR PARAHYDROGEN.

| IDENT | T K | T1968 K | PRESSURE BAR | DENSITY MOL/L EXP | DENSITY MOL/L CALC | DIFFERENCE PERCENT |
|---|---|---|---|---|---|---|
| 1301 | 32 | 32.008 | 59.937 | 32.596 | 32.586 | -0.03 |
| 1302 | 75 | 74.994 | 352.603 | 32.311 | 32.332 | 0.07 |
| 1303 | 80 | 79.991 | 384.451 | 32.284 | 32.306 | 0.07 |
| 1304 | 85 | 84.997 | 415.894 | 32.259 | 32.280 | 0.06 |
| 1305 | 90 | 90.010 | 446.920 | 32.234 | 32.253 | 0.06 |
| 1306 | 95 | 95.013 | 477.572 | 32.210 | 32.227 | 0.05 |
| 1307 | 100 | 100.010 | 507.845 | 32.186 | 32.201 | 0.05 |
| 1308 | 110 | 109.998 | 567.328 | 32.141 | 32.151 | 0.03 |
| 1309 | 120 | 119.989 | 625.492 | 32.100 | 32.106 | 0.02 |
| 1310 | 130 | 129.987 | 682.573 | 32.058 | 32.066 | 0.03 |
| 1311 | 140 | 139.992 | 738.622 | 32.019 | 32.037 | 0.05 |
| 1312 | 150 | 150.000 | 793.538 | 31.980 | 32.007 | 0.08 |
| 1401 | 30 | 30.008 | 58.358 | 33.620 | 33.598 | -0.07 |
| 1402 | 50 | 50.013 | 207.837 | 33.463 | 33.463 | -0.00 |
| 1403 | 75 | 74.994 | 382.639 | 33.308 | 33.313 | 0.02 |
| 1404 | 80 | 79.991 | 416.178 | 33.282 | 33.285 | 0.01 |
| 1405 | 85 | 84.997 | 449.311 | 33.255 | 33.258 | 0.01 |
| 1406 | 90 | 90.010 | 482.028 | 33.230 | 33.231 | 0.00 |
| 1407 | 95 | 95.013 | 514.302 | 33.205 | 33.204 | -0.00 |
| 1408 | 100 | 100.010 | 546.197 | 33.181 | 33.178 | -0.01 |
| 1409 | 110 | 109.998 | 608.714 | 33.136 | 33.125 | -0.03 |
| 1410 | 120 | 119.989 | 669.997 | 33.092 | 33.083 | -0.03 |
| 1411 | 130 | 129.987 | 729.976 | 33.049 | 33.042 | -0.02 |
| 1501 | 40 | 40.015 | 88.842 | 30.459 | 30.452 | -0.02 |
| 1502 | 90 | 90.010 | 381.413 | 30.184 | 30.199 | 0.05 |
| 1503 | 95 | 95.013 | 408.790 | 30.161 | 30.176 | 0.05 |
| 1504 | 100 | 100.010 | 435.752 | 30.140 | 30.149 | 0.03 |
| 1505 | 110 | 109.998 | 488.889 | 30.098 | 30.099 | 0.00 |
| 1506 | 120 | 119.989 | 540.928 | 30.057 | 30.051 | -0.02 |
| 1507 | 130 | 129.987 | 592.073 | 30.018 | 30.007 | -0.04 |
| 1508 | 140 | 139.992 | 642.361 | 29.980 | 29.968 | -0.04 |
| 1509 | 150 | 150.000 | 691.791 | 29.944 | 29.930 | -0.05 |
| 1601 | 40 | 40.015 | 108.357 | 31.952 | 31.954 | 0.00 |
| 1602 | 85 | 84.997 | 397.237 | 31.685 | 31.697 | 0.04 |
| 1603 | 90 | 90.010 | 427.302 | 31.660 | 31.671 | 0.04 |
| 1604 | 95 | 95.013 | 456.954 | 31.637 | 31.644 | 0.02 |
| 1605 | 100 | 100.010 | 486.298 | 31.614 | 31.619 | 0.02 |
| 1606 | 110 | 109.998 | 543.922 | 31.570 | 31.568 | -0.01 |
| 1607 | 120 | 119.989 | 600.411 | 31.528 | 31.525 | -0.01 |

TABLE I. EXPERIMENTAL PVT DATA FOR PARAHYDROGEN.

| IDENT | T K | T1968 K | PRESSURE BAR | DENSITY MOL/L EXP | DENSITY MOL/L CALC | DIFFERENCE PERCENT |
|---|---|---|---|---|---|---|
| 1701 | 40 | 40.015 | 103.003 | 31.570 | 31.576 | 0.02 |
| 1702 | 85 | 84.997 | 385.634 | 31.306 | 31.322 | 0.05 |
| 1703 | 90 | 90.010 | 415.149 | 31.281 | 31.299 | 0.06 |
| 1704 | 95 | 95.013 | 444.215 | 31.258 | 31.273 | 0.05 |
| 1705 | 100 | 100.010 | 472.905 | 31.235 | 31.246 | 0.04 |
| 1706 | 110 | 109.998 | 529.322 | 31.191 | 31.194 | 0.01 |
| 1707 | 120 | 119.989 | 584.640 | 31.149 | 31.148 | -0.00 |
| 1708 | 130 | 129.987 | 638.928 | 31.109 | 31.107 | -0.01 |
| 1709 | 140 | 139.992 | 692.286 | 31.070 | 31.074 | 0.01 |
| 1801 | 40 | 40.015 | 68.910 | 28.426 | 28.425 | -0.00 |
| 1802 | 90 | 90.010 | 327.437 | 28.170 | 28.195 | 0.09 |
| 1803 | 95 | 95.013 | 351.749 | 28.149 | 28.174 | 0.09 |
| 1804 | 100 | 100.010 | 375.753 | 28.128 | 28.150 | 0.08 |
| 1805 | 110 | 109.998 | 423.038 | 28.088 | 28.102 | 0.05 |
| 1806 | 120 | 119.989 | 469.466 | 28.050 | 28.055 | 0.02 |
| 1807 | 130 | 129.987 | 515.069 | 28.013 | 28.009 | -0.02 |
| 1901 | 24 | 24.008 | 278.691 | 43.021 | 42.998 | -0.05 |
| 1902 | 32 | 32.008 | 368.296 | 42.945 | 42.936 | -0.02 |
| 1903 | 33 | 33.009 | 379.592 | 42.935 | 42.929 | -0.01 |
| 1904 | 34 | 34.010 | 390.784 | 42.926 | 42.919 | -0.02 |
| 1905 | 35 | 35.011 | 402.045 | 42.917 | 42.912 | -0.01 |
| 1906 | 36 | 36.012 | 413.308 | 42.909 | 42.904 | -0.01 |
| 1907 | 37 | 37.013 | 424.501 | 42.900 | 42.895 | -0.01 |
| 1908 | 38 | 38.014 | 435.729 | 42.891 | 42.887 | -0.01 |
| 1909 | 39 | 39.015 | 446.957 | 42.883 | 42.879 | -0.01 |
| 1910 | 40 | 40.015 | 458.150 | 42.874 | 42.871 | -0.01 |
| 1911 | 42 | 42.016 | 480.504 | 42.858 | 42.855 | -0.01 |
| 1912 | 44 | 44.015 | 502.720 | 42.841 | 42.838 | -0.01 |
| 1913 | 46 | 46.015 | 524.588 | 42.825 | 42.816 | -0.02 |
| 1914 | 48 | 48.014 | 546.840 | 42.810 | 42.803 | -0.02 |
| 1915 | 50 | 50.013 | 568.919 | 42.794 | 42.789 | -0.01 |
| 1916 | 55 | 55.007 | 623.689 | 42.757 | 42.755 | -0.01 |
| 1917 | 60 | 59.999 | 677.705 | 42.721 | 42.721 | 0.00 |
| 1918 | 65 | 65.000 | 731.138 | 42.688 | 42.692 | 0.01 |
| 1919 | 70 | 70.000 | 783.712 | 42.655 | 42.664 | 0.02 |

TABLE I. EXPERIMENTAL PVT DATA FOR PARAHYDROGEN.

| IDENT | T K | T1968 K | PRESSURE BAR | DENSITY MOL/L EXP | DENSITY MOL/L CALC | DIFFERENCE PERCENT |
|---|---|---|---|---|---|---|
| 2001 | 23 | 23.009 | 312.698 | 43.898 | 43.876 | -0.05 |
| 2002 | 24 | 24.008 | 324.063 | 43.888 | 43.869 | -0.04 |
| 2003 | 26 | 26.007 | 346.928 | 43.869 | 43.854 | -0.04 |
| 2004 | 28 | 28.007 | 369.863 | 43.850 | 43.837 | -0.03 |
| 2005 | 30 | 30.008 | 392.936 | 43.832 | 43.821 | -0.03 |
| 2006 | 31 | 31.008 | 404.507 | 43.822 | 43.813 | -0.02 |
| 2007 | 32 | 32.008 | 416.078 | 43.813 | 43.805 | -0.02 |
| 2008 | 33 | 33.009 | 427.650 | 43.805 | 43.797 | -0.02 |
| 2009 | 34 | 34.010 | 439.223 | 43.796 | 43.789 | -0.02 |
| 2010 | 35 | 35.011 | 450.862 | 43.787 | 43.782 | -0.01 |
| 2011 | 36 | 36.012 | 462.401 | 43.779 | 43.773 | -0.01 |
| 2012 | 37 | 37.013 | 474.007 | 43.770 | 43.766 | -0.01 |
| 2013 | 38 | 38.014 | 485.580 | 43.761 | 43.758 | -0.01 |
| 2014 | 39 | 39.015 | 497.152 | 43.753 | 43.750 | -0.01 |
| 2015 | 42 | 42.016 | 531.729 | 43.728 | 43.727 | -0.00 |
| 2015 | 40 | 40.015 | 508.686 | 43.745 | 43.742 | -0.01 |
| 2017 | 44 | 44.015 | 554.704 | 43.712 | 43.712 | -0.00 |
| 2018 | 46 | 46.015 | 577.609 | 43.697 | 43.697 | -0.00 |
| 2019 | 48 | 48.014 | 600.408 | 43.681 | 43.682 | 0.00 |
| 2020 | 50 | 50.013 | 623.142 | 43.666 | 43.667 | 0.00 |
| 2021 | 55 | 55.007 | 679.500 | 43.629 | 43.632 | 0.01 |
| 2022 | 60 | 59.999 | 735.171 | 43.594 | 43.599 | 0.01 |
| 2023 | 65 | 65.000 | 790.154 | 43.560 | 43.569 | 0.02 |
| 2101 | 24 | 24.008 | 225.819 | 41.882 | 41.865 | -0.04 |
| 2102 | 26 | 26.007 | 247.336 | 41.863 | 41.851 | -0.03 |
| 2104 | 34 | 34.010 | 334.042 | 41.788 | 41.789 | 0.00 |
| 2105 | 36 | 36.012 | 355.737 | 41.770 | 41.773 | 0.01 |
| 2106 | 38 | 38.014 | 377.398 | 41.752 | 41.757 | 0.01 |
| 2107 | 40 | 40.015 | 398.956 | 41.735 | 41.741 | 0.01 |
| 2108 | 42 | 42.016 | 420.478 | 41.718 | 41.725 | 0.02 |
| 2109 | 44 | 44.015 | 441.832 | 41.702 | 41.707 | 0.01 |
| 2110 | 46 | 46.015 | 463.185 | 41.686 | 41.691 | 0.01 |
| 2111 | 48 | 48.014 | 484.398 | 41.670 | 41.675 | 0.01 |
| 2112 | 50 | 50.013 | 505.545 | 41.655 | 41.659 | 0.01 |
| 2113 | 55 | 55.007 | 557.865 | 41.618 | 41.619 | 0.00 |
| 2114 | 60 | 59.999 | 609.567 | 41.582 | 41.583 | 0.00 |
| 2115 | 65 | 65.000 | 660.616 | 41.548 | 41.549 | 0.00 |
| 2116 | 70 | 70.000 | 711.014 | 41.515 | 41.520 | 0.01 |

TABLE I. EXPERIMENTAL PVT DATA FOR PARAHYDROGEN.

| IDENT | T K | T1968 K | PRESSURE BAR | DENSITY MOL/L EXP | DENSITY MOL/L CALC | DIFFERENCE PERCENT |
|---|---|---|---|---|---|---|
| 2201 | 30 | 30.008 | 157.922 | 38.255 | 38.258 | 0.01 |
| 2202 | 40 | 40.015 | 252.794 | 38.164 | 38.188 | 0.06 |
| 2203 | 55 | 55.007 | 390.663 | 38.047 | 38.078 | 0.08 |
| 2204 | 60 | 59.999 | 435.320 | 38.013 | 38.041 | 0.07 |
| 2205 | 65 | 65.000 | 479.370 | 37.979 | 38.005 | 0.07 |
| 2206 | 70 | 70.000 | 524.833 | 37.946 | 38.015 | 0.18 |
| 2207 | 75 | 74.994 | 565.476 | 37.917 | 37.936 | 0.05 |
| 2208 | 80 | 79.991 | 607.601 | 37.887 | 37.903 | 0.04 |
| 2209 | 85 | 84.997 | 649.245 | 37.859 | 37.875 | 0.04 |
| 2210 | 90 | 90.010 | 690.340 | 37.832 | 37.849 | 0.04 |
| 2211 | 95 | 95.013 | 730.852 | 37.805 | 37.825 | 0.05 |
| 2301 | 60 | 59.999 | 141.529 | 25.729 | 25.738 | 0.03 |
| 2302 | 90 | 90.010 | 270.164 | 25.602 | 25.635 | 0.13 |
| 2303 | 110 | 109.998 | 351.804 | 25.528 | 25.554 | 0.10 |
| 2305 | 130 | 129.987 | 430.771 | 25.459 | 25.474 | 0.06 |
| 2306 | 140 | 139.992 | 469.379 | 25.426 | 25.437 | 0.04 |
| 2307 | 150 | 150.000 | 507.403 | 25.394 | 25.400 | 0.02 |
| 2308 | 160 | 160.010 | 544.981 | 25.362 | 25.365 | 0.01 |
| 2309 | 170 | 170.019 | 582.008 | 25.331 | 25.331 | -0.00 |
| 2310 | 180 | 180.027 | 618.659 | 25.301 | 25.300 | -0.00 |
| 2311 | 190 | 190.032 | 654.759 | 25.271 | 25.270 | -0.00 |
| 2312 | 200 | 200.035 | 690.517 | 25.241 | 25.242 | 0.00 |
| 2313 | 220 | 220.030 | 760.801 | 25.184 | 25.191 | 0.03 |
| 2402 | 110 | 109.998 | 293.108 | 23.035 | 23.051 | 0.07 |
| 2403 | 120 | 119.989 | 326.842 | 23.004 | 23.015 | 0.05 |
| 2404 | 130 | 129.987 | 360.140 | 22.973 | 22.981 | 0.04 |
| 2405 | 140 | 139.992 | 392.995 | 22.943 | 22.948 | 0.02 |
| 2406 | 150 | 150.000 | 425.403 | 22.914 | 22.915 | 0.00 |
| 2407 | 160 | 160.010 | 457.434 | 22.885 | 22.884 | -0.01 |
| 2408 | 180 | 180.027 | 520.362 | 22.828 | 22.822 | -0.02 |
| 2409 | 190 | 190.032 | 551.291 | 22.800 | 22.793 | -0.03 |
| 2410 | 200 | 200.035 | 581.946 | 22.773 | 22.766 | -0.03 |
| 2411 | 220 | 220.030 | 642.195 | 22.720 | 22.713 | -0.03 |
| 2412 | 240 | 240.020 | 701.378 | 22.666 | 22.665 | -0.01 |
| 2413 | 260 | 260.008 | 759.220 | 22.615 | 22.616 | 0.00 |

TABLE I. EXPERIMENTAL PVT DATA FOR PARAHYDROGEN.

| IDENT | T K | T1968 K | PRESSURE BAR | DENSITY MOL/L EXP | DENSITY MOL/L CALC | DIFFERENCE PERCENT |
|---|---|---|---|---|---|---|
| 2501 | 75 | 74.994 | 218.132 | 26.356 | 26.376 | 0.08 |
| 2502 | 90 | 90.010 | 284.399 | 26.293 | 26.322 | 0.11 |
| 2503 | 110 | 109.998 | 369.686 | 26.217 | 26.238 | 0.08 |
| 2504 | 120 | 119.989 | 411.185 | 26.181 | 26.195 | 0.05 |
| 2505 | 130 | 129.987 | 452.061 | 26.147 | 26.154 | 0.03 |
| 2506 | 140 | 139.992 | 492.322 | 26.113 | 26.115 | 0.01 |
| 2507 | 150 | 150.000 | 531.966 | 26.080 | 26.077 | -0.01 |
| 2508 | 160 | 160.010 | 571.131 | 26.048 | 26.041 | -0.03 |
| 2509 | 170 | 170.019 | 609.744 | 26.016 | 26.007 | -0.04 |
| 2510 | 180 | 180.027 | 647.880 | 25.985 | 25.978 | -0.03 |
| 2511 | 190 | 190.032 | 685.499 | 25.955 | 25.947 | -0.03 |
| 2512 | 200 | 200.035 | 722.705 | 25.925 | 25.918 | -0.03 |
| 2601 | 90 | 90.010 | 156.817 | 18.359 | 18.369 | 0.05 |
| 2602 | 110 | 109.998 | 205.359 | 18.308 | 18.322 | 0.08 |
| 2603 | 120 | 119.989 | 229.174 | 18.284 | 18.297 | 0.07 |
| 2604 | 130 | 129.987 | 252.750 | 18.259 | 18.273 | 0.07 |
| 2605 | 140 | 139.992 | 276.062 | 18.236 | 18.248 | 0.07 |
| 2606 | 150 | 150.000 | 299.141 | 18.212 | 18.223 | 0.06 |
| 2607 | 160 | 160.010 | 321.972 | 18.189 | 18.198 | 0.05 |
| 2608 | 170 | 170.019 | 344.632 | 18.167 | 18.175 | 0.05 |
| 2609 | 180 | 180.027 | 367.002 | 18.144 | 18.150 | 0.03 |
| 2610 | 190 | 190.032 | 389.217 | 18.122 | 18.125 | 0.02 |
| 2611 | 200 | 200.035 | 411.235 | 18.100 | 18.101 | 0.01 |
| 2612 | 240 | 240.020 | 497.406 | 18.013 | 18.008 | -0.03 |
| 2613 | 260 | 260.008 | 539.599 | 17.969 | 17.968 | -0.01 |
| 2614 | 260 | 260.008 | 539.738 | 17.972 | 17.971 | -0.01 |
| 2615 | 280 | 279.997 | 581.278 | 17.929 | 17.931 | 0.01 |
| 2616 | 300 | 299.992 | 622.235 | 17.885 | 17.892 | 0.04 |
| 2701 | 90 | 90.010 | 148.812 | 17.700 | 17.689 | -0.06 |
| 2702 | 110 | 109.998 | 194.811 | 17.651 | 17.650 | -0.01 |
| 2703 | 120 | 119.989 | 217.364 | 17.628 | 17.626 | -0.01 |
| 2704 | 130 | 129.987 | 239.653 | 17.605 | 17.600 | -0.03 |
| 2705 | 140 | 139.992 | 261.781 | 17.582 | 17.578 | -0.02 |
| 2706 | 150 | 150.000 | 283.773 | 17.560 | 17.559 | -0.00 |
| 2707 | 160 | 160.010 | 305.502 | 17.538 | 17.538 | -0.00 |
| 2708 | 170 | 170.019 | 327.037 | 17.516 | 17.517 | 0.00 |
| 2709 | 180 | 180.027 | 348.330 | 17.494 | 17.493 | -0.01 |
| 2710 | 190 | 190.032 | 369.429 | 17.473 | 17.469 | -0.02 |
| 2711 | 200 | 200.035 | 390.357 | 17.452 | 17.447 | -0.03 |
| 2712 | 220 | 220.030 | 431.688 | 17.409 | 17.402 | -0.04 |
| 2713 | 220 | 220.030 | 431.788 | 17.409 | 17.405 | -0.02 |
| 2714 | 240 | 240.020 | 472.475 | 17.368 | 17.362 | -0.03 |
| 2715 | 260 | 260.008 | 512.554 | 17.326 | 17.321 | -0.03 |
| 2716 | 280 | 279.997 | 552.092 | 17.285 | 17.282 | -0.02 |
| 2717 | 300 | 299.992 | 591.119 | 17.243 | 17.245 | 0.01 |

TABLE I. EXPERIMENTAL PVT DATA FOR PARAHYDROGEN.

| IDENT | T K | T1968 K | PRESSURE BAR | DENSITY MOL/L EXP | DENSITY MOL/L CALC | DIFFERENCE PERCENT |
|---|---|---|---|---|---|---|
| 2801 | 90 | 90.010 | 125.090 | 15.492 | 15.506 | 0.09 |
| 2802 | 110 | 109.998 | 163.128 | 15.451 | 15.468 | 0.11 |
| 2803 | 120 | 119.989 | 181.823 | 15.431 | 15.444 | 0.09 |
| 2804 | 130 | 129.987 | 200.324 | 15.411 | 15.420 | 0.06 |
| 2805 | 140 | 139.992 | 218.687 | 15.391 | 15.399 | 0.05 |
| 2806 | 150 | 150.000 | 236.887 | 15.372 | 15.377 | 0.03 |
| 2807 | 160 | 160.010 | 254.928 | 15.353 | 15.356 | 0.02 |
| 2808 | 170 | 170.019 | 272.833 | 15.334 | 15.336 | 0.01 |
| 2809 | 180 | 180.027 | 290.588 | 15.315 | 15.316 | 0.00 |
| 2810 | 190 | 190.032 | 308.184 | 15.296 | 15.295 | -0.01 |
| 2811 | 200 | 200.035 | 325.630 | 15.278 | 15.274 | -0.02 |
| 2812 | 220 | 220.030 | 360.177 | 15.241 | 15.236 | -0.03 |
| 2813 | 240 | 240.020 | 394.200 | 15.204 | 15.199 | -0.04 |
| 2814 | 260 | 260.008 | 427.862 | 15.167 | 15.166 | -0.01 |
| 2815 | 280 | 279.997 | 461.046 | 15.130 | 15.134 | 0.03 |
| 2816 | 300 | 299.992 | 493.856 | 15.094 | 15.105 | 0.07 |
| 2901 | 110 | 109.998 | 123.395 | 12.334 | 12.342 | 0.06 |
| 2902 | 120 | 119.989 | 137.165 | 12.319 | 12.321 | 0.01 |
| 2903 | 130 | 129.987 | 150.861 | 12.303 | 12.302 | -0.00 |
| 2904 | 140 | 139.992 | 164.465 | 12.288 | 12.285 | -0.02 |
| 2905 | 150 | 150.000 | 177.996 | 12.273 | 12.270 | -0.02 |
| 2906 | 160 | 160.010 | 191.354 | 12.257 | 12.252 | -0.04 |
| 2907 | 170 | 170.019 | 204.668 | 12.242 | 12.236 | -0.05 |
| 2908 | 180 | 180.027 | 217.866 | 12.227 | 12.219 | -0.06 |
| 2909 | 190 | 190.032 | 230.996 | 12.212 | 12.205 | -0.06 |
| 2910 | 200 | 200.035 | 243.995 | 12.197 | 12.188 | -0.07 |
| 2911 | 220 | 220.030 | 269.775 | 12.167 | 12.158 | -0.07 |
| 2912 | 240 | 240.020 | 295.275 | 12.137 | 12.132 | -0.04 |
| 2913 | 260 | 260.008 | 320.391 | 12.107 | 12.105 | -0.02 |
| 2914 | 280 | 279.997 | 345.310 | 12.077 | 12.082 | 0.04 |
| 2915 | 300 | 299.992 | 369.931 | 12.047 | 12.061 | 0.11 |
| 3001 | 120 | 119.989 | 108.442 | 10.063 | 10.065 | 0.02 |
| 3002 | 130 | 129.987 | 119.044 | 10.051 | 10.051 | 0.00 |
| 3003 | 140 | 139.992 | 129.535 | 10.039 | 10.035 | -0.04 |
| 3004 | 150 | 150.000 | 139.977 | 10.026 | 10.021 | -0.05 |
| 3005 | 160 | 160.010 | 150.362 | 10.014 | 10.008 | -0.06 |
| 3006 | 170 | 170.019 | 160.668 | 10.002 | 9.995 | -0.07 |
| 3007 | 180 | 180.027 | 170.906 | 9.989 | 9.981 | -0.08 |
| 3008 | 190 | 190.032 | 181.086 | 9.977 | 9.969 | -0.08 |
| 3009 | 200 | 200.035 | 191.208 | 9.964 | 9.956 | -0.08 |
| 3010 | 220 | 220.030 | 211.270 | 9.940 | 9.932 | -0.08 |
| 3011 | 240 | 240.020 | 231.147 | 9.916 | 9.911 | -0.05 |
| 3012 | 260 | 260.008 | 250.762 | 9.891 | 9.890 | -0.01 |
| 3013 | 280 | 279.997 | 270.209 | 9.866 | 9.871 | 0.05 |
| 3014 | 300 | 299.992 | 289.509 | 9.841 | 9.855 | 0.14 |

TABLE I. EXPERIMENTAL PVT DATA FOR PARAHYDROGEN.

| IDENT | T K | T1968 K | PRESSURE BAR | DENSITY MOL/L EXP | DENSITY MOL/L CALC | DIFFERENCE PERCENT |
|---|---|---|---|---|---|---|
| 3101 | 90 | 90.010 | 194.700 | 21.223 | 21.235 | 0.06 |
| 3102 | 110 | 109.998 | 255.139 | 21.163 | 21.175 | 0.06 |
| 3103 | 120 | 119.989 | 284.741 | 21.134 | 21.145 | 0.05 |
| 3104 | 130 | 129.987 | 313.941 | 21.106 | 21.114 | 0.04 |
| 3105 | 140 | 139.992 | 342.799 | 21.078 | 21.084 | 0.03 |
| 3106 | 150 | 150.000 | 371.346 | 21.051 | 21.055 | 0.02 |
| 3107 | 160 | 160.010 | 399.551 | 21.025 | 21.027 | 0.01 |
| 3108 | 170 | 170.019 | 427.447 | 20.999 | 20.999 | 0.00 |
| 3109 | 180 | 180.027 | 455.033 | 20.974 | 20.971 | -0.01 |
| 3110 | 190 | 190.032 | 482.285 | 20.949 | 20.942 | -0.03 |
| 3111 | 200 | 200.035 | 509.356 | 20.924 | 20.917 | -0.04 |
| 3112 | 220 | 220.030 | 562.623 | 20.874 | 20.864 | -0.05 |
| 3113 | 240 | 240.020 | 614.990 | 20.826 | 20.817 | -0.04 |
| 3114 | 260 | 260.008 | 666.444 | 20.777 | 20.771 | -0.03 |
| 3115 | 280 | 279.997 | 717.092 | 20.729 | 20.730 | 0.00 |
| 3116 | 300 | 299.992 | 766.252 | 20.680 | 20.678 | -0.01 |
| 1 | 300 | 299.992 | 110.696 | 4.160 | 4.164 | 0.09 |

TABLE II. PARAMETERS USED IN EQUATIONS (2), WITH P IN ATMOSPHERES, IN MOL/CM$^3$.

T = 17

| | | | |
|---|---|---|---|
| 1.7927586453+006 | -1.5192441462+008 | 3.8076380874+009 | -2.8011219719+010 |

T = 18

| | | | |
|---|---|---|---|
| 1.5031197572+007 | -1.5512871509+009 | 5.9237216873+010 | -1.0027960622+012 |
| 6.4214968758+012 | | | |

T = 19

| | | | |
|---|---|---|---|
| -1.1392285021+006 | 1.2356609580+008 | -5.7620943087+009 | 1.1774618892+011 |
| -8.1884732011+011 | | | |

T = 20

| | | | |
|---|---|---|---|
| -8.9024745380+007 | 1.1556129859+010 | -6.0013225905+011 | 1.5555518278+013 |
| -2.0113758594+014 | 1.0388479790+015 | | |

T = 21

| | | | |
|---|---|---|---|
| -1.5722719776+006 | 1.9651870236+008 | -1.0575412034+010 | 2.7455063588+011 |
| -3.3294287572+012 | 1.5784513601+013 | | |

T = 22

| | | | |
|---|---|---|---|
| -6.2220964791+006 | 8.1215152736+008 | -4.3140892647+010 | 1.1354740706+012 |
| -1.4701306157+013 | 7.5808848429+013 | | |

T = 23

| | | | |
|---|---|---|---|
| 1.1938646749+007 | -1.5789479208+009 | 8.2547745700+010 | -2.1610303925+012 |
| 2.8440149149+013 | -1.4958283915+014 | | |

T = 24

| | | | |
|---|---|---|---|
| -2.3878490330+005 | 3.0395018355+007 | -1.3734369824+010 | 1.8909616802+012 |
| -1.2142525399+014 | 4.2564284763+015 | -8.4197211599+016 | 8.8715230634+017 |
| -3.8860226726+018 | | | |

T = 25

| | | | |
|---|---|---|---|
| 1.9101085827+007 | -1.3258059406+010 | 2.0705538414+012 | -1.5338042955+014 |
| 6.4844143415+015 | -1.6611547693+017 | 2.5633271853+018 | -2.2002900684+019 |
| 8.0936167398+019 | | | |

T = 26

| | | | |
|---|---|---|---|
| -2.1530400926+005 | 5.6158308351+006 | -1.2726310972+009 | 2.7828310003+011 |
| -2.3982606455+013 | 1.0294067329+015 | -2.3633418379+016 | 2.8068341347+017 |
| -1.3625971008+018 | | | |

T = 27

| | | | |
|---|---|---|---|
| 6.3601655201+006 | -3.4433188539+009 | 5.1608398468+011 | -3.7921435957+013 |
| 1.6073005389+015 | -4.1465379553+016 | 6.4586567057+017 | -5.6034492132+018 |
| 2.0849174834+019 | | | |

TABLE II. PARAMETERS USED IN EQUATIONS (2), WITH P IN ATMOSPHERES, IN MOL/CM$^3$.

| | | | |
|---|---|---|---|
| T = 28 | | | |
| -2.0595703167+005 | 4.5182352997+006 | -6.8612022421+008 | 1.7592192748+011 |
| -1.6152013770+013 | 7.1802377310+014 | -1.6868583740+016 | 2.0429300583+017 |
| -1.0112661614+018 | | | |
| T = 29 | | | |
| -1.3428110367+007 | 5.6575732735+009 | -8.2947559839+011 | 6.2421479049+013 |
| -2.7579075595+015 | 7.4796689348+016 | -1.2297564767+018 | 1.1284301969+019 |
| -4.4448339829+019 | | | |
| T = 30 | | | |
| -2.0017952378+005 | 5.3964044936+006 | -4.2058231059+008 | 2.6939742148+010 |
| 4.8294203363+012 | -7.6785061024+014 | 4.5537740208+016 | -1.4318146279+018 |
| 2.5469426200+019 | -2.4344222806+020 | 9.7614646410+020 | |
| T = 31 | | | |
| -1.9516670204+005 | 3.6574613418+006 | 3.7466996841+008 | -1.3784282679+011 |
| 2.3239446305+013 | -2.0061113068+015 | 9.8185403161+016 | -2.8568579115+018 |
| 4.9261084486+019 | -4.6663844523+020 | 1.8758074023+021 | |
| T = 32 | | | |
| -1.9206741710+005 | 4.6845686588+006 | -3.6150845963+008 | 1.2104653786+011 |
| -2.6458186348+013 | 3.7166512756+015 | -3.2574421486+017 | 1.8132111800+019 |
| -6.5371484854+020 | 1.5269776599+022 | -2.2367832329+023 | 1.8715165426+024 |
| -6.8355209137+024 | | | |
| T = 33 | | | |
| -1.8784938302+005 | 2.6577854073+006 | 1.4510362165+009 | -6.7103915231+011 |
| 1.7491421424+014 | -2.8719174322+016 | 3.1652595468+018 | -2.4196373064+020 |
| 1.3041812918+022 | -4.9821628964+023 | 1.3400288556+025 | -2.4805831839+026 |
| 3.0081285610+027 | -2.1514260620+028 | 6.8799325371+028 | |
| T = 34 | | | |
| -1.8585184564+005 | 5.5750148466+006 | -7.6024834019+008 | 2.0507512304+011 |
| -3.4321343187+013 | 3.8295375311+015 | -2.8662841004+017 | 1.4381045765+019 |
| -4.8273615233+020 | 1.0697128449+022 | -1.5028432355+023 | 1.2137075915+024 |
| -4.2943871162+024 | | | |
| T = 35 | | | |
| -1.8119509449+005 | 3.7749485685+006 | 1.9397696413+008 | -5.7703648590+010 |
| 8.8885819309+012 | -7.4038751137+014 | 3.5528922435+016 | -1.0158372332+018 |
| 1.7266459572+019 | -1.6217236626+020 | 6.5142512016+020 | |
| T = 36 | | | |
| -1.7811391467+005 | 4.1182933578+006 | 2.4961851164+007 | -1.8655489452+010 |
| 3.8454860809+012 | -3.5775575669+014 | 1.7787367946+016 | -5.0468821411+017 |
| 8.3049534499+018 | -7.4389397677+019 | 2.8224550378+020 | |

TABLE II. PARAMETERS USED IN EQUATIONS (2), WITH P IN ATMOSPHERES, IN MOL/CM$^3$.

T = 37

| | | | |
|---|---|---|---|
| -1.7504164625+005 | 4.3478341863+006 | -7.8940145097+007 | 3.7751222751+009 |
| 1.0481902322+012 | -1.5188318013+014 | 8.6169811247+015 | -2.5436161152+017 |
| 4.2115621654+018 | -3.7645346224+019 | 1.4349996701+020 | |

T = 38

| | | | |
|---|---|---|---|
| -1.7188655461+005 | 4.4164814100+006 | -1.2310743431+008 | 1.5313645270+010 |
| -6.4757887779+011 | -9.4967659665+012 | 1.4841742662+015 | -3.5097239605+016 |
| 1.3185365598+017 | 4.6721412435+018 | -4.4688264278+019 | |

T = 39

| | | | |
|---|---|---|---|
| -1.6871486896+005 | 4.3494489187+006 | -9.6149707960+007 | 9.3603784130+009 |
| 5.1049105615+010 | -6.3993969203+013 | 4.4733401634+015 | -1.4374657538+017 |
| 2.5526792404+018 | -2.4969242889+019 | 1.0756029041+020 | |

T = 40

| | | | |
|---|---|---|---|
| -1.6528799255+005 | 4.0424879157+006 | -6.4224280969+006 | -4.2051370364+009 |
| 1.1853205298+012 | -1.2229345288+014 | 6.4811436791+015 | -1.9139164278+017 |
| 3.3010243575+018 | -3.1872436252+019 | 1.3536613430+020 | |

T = 42

| | | | |
|---|---|---|---|
| -1.6005141176+005 | 4.7838903840+006 | -2.9327650297+003 | 5.1102200113+010 |
| -5.1559965190+012 | 3.3297229502+014 | -1.4362689717+016 | 4.1737762048+017 |
| -7.6922454819+018 | 8.0054237088+019 | -3.5598893687+020 | |

T = 44

| | | | |
|---|---|---|---|
| -1.5415213997+005 | 4.5484784748+006 | -1.7363000323+008 | 2.2532145910+010 |
| -1.5170646500+012 | 5.5621434507+013 | -9.9586051707+014 | 8.4449832218+015 |
| -2.6782002109+016 | | | |

T = 46

| | | | |
|---|---|---|---|
| -1.4849319717+005 | 4.4556006236+006 | -1.3686177327+008 | 1.6333384342+010 |
| -1.0266946025+012 | 3.6133000363+013 | -5.8512342722+014 | 4.0570803551+015 |
| -8.2553809655+015 | | | |

T = 48

| | | | |
|---|---|---|---|
| -1.4323003079+005 | 4.6101570489+006 | -1.7559747323+008 | 2.1142514479+010 |
| -1.3855258854+012 | 5.3741360391+013 | -1.1000290742+015 | 1.1984378664+016 |
| -5.7512269202+016 | | | |

T = 50

| | | | |
|---|---|---|---|
| -1.3755039297+005 | 4.4337521733+006 | -1.2683328076+008 | 1.4384430007+010 |
| -8.7711843003+011 | 3.3093906556+013 | -6.3704229711+014 | 6.5595795531+015 |
| -3.1619037425+016 | | | |

TABLE II. PARAMETERS USED IN EQUATIONS (2), WITH P IN ATMOSPHERES, IN MOL/CM$^3$.

| | | | |
|---|---|---|---|
| T = 55 | | | |
| -1.2444464680+005 | 4.4263980428+006 | -1.1117629197+008 | 1.1536268864+010 |
| -6.2833472919+011 | 2.4237788412+013 | -5.1031540831+014 | 6.3172360032+015 |
| -3.8295182637+016 | | | |
| T = 60 | | | |
| -1.1121912936+005 | 3.7936057214+006 | 9.6693596677+007 | -1.7339142479+010 |
| 1.5493318633+012 | -6.7845664772+013 | 1.6933951450+015 | -2.1656447852+016 |
| 1.0813339700+017 | | | |
| T = 65 | | | |
| -9.8720106145+004 | 3.7003113011+006 | 1.4986070139+008 | -2.5788521979+010 |
| 2.3050068184+012 | -1.0443828491+014 | 2.6776241089+015 | -3.5561177409+016 |
| 1.8848759867+017 | | | |
| T = 70 | | | |
| -8.8718903663+004 | 5.1753661577+006 | -2.0146770020+008 | 1.7718411591+010 |
| -6.6024659429+011 | 1.4663058585+013 | -1.2203529654+014 | |
| T = 75 | | | |
| -7.8025954959+004 | 5.6523931462+006 | -2.6639813355+008 | 2.3447414566+010 |
| -9.0042851805+011 | 1.9664936592+013 | -1.6363534789+014 | |
| T = 80 | | | |
| -6.6186969522+004 | 5.5655865573+006 | -2.3514178364+008 | 2.1345811734+010 |
| -8.1467914805+011 | 1.7944899990+013 | -1.5097001241+014 | |
| T = 85 | | | |
| -5.4213554657+004 | 5.3107666819+006 | -1.6977750444+008 | 1.6309382732+010 |
| -6.0735692987+011 | 1.3818270020+013 | -1.2005059027+014 | |
| T = 90 | | | |
| -4.2626080752+004 | 5.2768485401+006 | -1.4350544917+008 | 1.4119783096+010 |
| -4.9336104804+011 | 1.0974869627+013 | -9.4195262066+013 | |
| T = 95 | | | |
| -3.2113968030+004 | 5.2533557761+006 | -6.7826875035+007 | 5.0485456231+009 |
| -2.2003037414+010 | | | |
| T = 100 | | | |
| -2.1222851074+004 | 5.2732115183+006 | -5.7074800540+007 | 4.8860145629+009 |
| -2.2358853579+010 | | | |
| T = 110 | | | |
| 3.1412601495+003 | 4.6471082519+006 | 2.4531366095+007 | 2.3853498831+009 |
| 3.2830235464+009 | | | |

TABLE II. PARAMETERS USED IN EQUATIONS (2), WITH P IN ATMOSPHERES, IN MOL/CM$^3$.

| | | | |
|---|---|---|---|
| T = 120 | | | |
| 2.6464489657+004 | 4.2070808336+006 | 8.6352691620+007 | 4.6370803380+008 |
| 2.4430261682+010 | | | |
| T = 130 | | | |
| 5.2710390907+004 | 3.3607590684+006 | 1.5809499545+009 | -1.1687218877+009 |
| 3.5545800087+010 | | | |
| T = 140 | | | |
| 8.2889587155+004 | 1.2750268682+006 | 3.4805726513+008 | -7.3716422103+009 |
| 1.0762848479+011 | | | |
| T = 150 | | | |
| 9.9132598618+004 | 2.2950896275+006 | 2.9170405067+008 | -5.4215509909+009 |
| 8.2837449894+010 | | | |
| T = 160 | | | |
| 1.1224730815+005 | 4.1479952727+006 | 1.4623482040+008 | 3.9067965812+008 |
| T = 170 | | | |
| 1.3448226329+005 | 3.8039602304+006 | 1.8450776633+008 | -3.3170631876+008 |
| T = 180 | | | |
| 1.5862494924+005 | 3.0672011100+006 | 2.4310127954+008 | -1.3859042662+009 |
| T = 190 | | | |
| 1.5923196446+005 | 6.7083029471+006 | 4.3210883954+007 | 2.3675454063+009 |
| T = 200 | | | |
| 1.7980369731+005 | 6.5195371178+006 | 7.0124286979+007 | 1.8674921622+009 |
| T = 220 | | | |
| 2.0871873375+005 | 8.3738065048+006 | -1.3391815780+007 | 3.5010356047+009 |
| T = 240 | | | |
| 2.5891748980+005 | 5.9776163601+006 | 1.6315401519+008 | |
| T = 260 | | | |
| 2.8886298627+005 | 7.0503327034+006 | 1.4305482371+008 | |
| T = 280 | | | |
| 3.2088095893+005 | 7.8342761934+006 | 1.2893277428+008 | |
| T = 300 | | | |
| 3.5755211794+005 | 8.0856780617+006 | 1.2555978890+009 | |

TABLE III. PARAMETERS USED IN EQUATIONS (3), WITH P IN ATMOSPHERES, T IN KELVINS

| | | | |
|---|---|---|---|
| DENSITY = 6.5 | | | |
| -7.6666428981-005 | 6.4889324389-001 | -1.0560439364+001 | 4.1486997680+001 |
| -1.3723015815+003 | | | |
| DENSITY = 7.0 | | | |
| -8.9392590199-005 | 7.0920300077-001 | -1.2219671284+001 | 4.9285316151+001 |
| -1.5778819633+003 | | | |
| DENSITY = 7.5 | | | |
| -1.0310817375-004 | 7.7113012411-001 | -1.3990496075+001 | 5.7339421316+001 |
| -1.7805277932+003 | | | |
| DENSITY = 8.0 | | | |
| -1.1698229150-004 | 8.3423216275-001 | -1.5796543231+001 | 6.1486587428+001 |
| -1.9059440030+003 | | | |
| DENSITY = 8.5 | | | |
| -1.3284976883-004 | 8.9939102824-001 | -1.7756597363+001 | 6.7878239674+001 |
| -2.0548102677+003 | | | |
| DENSITY = 9.0 | | | |
| -1.4912593340-004 | 9.6593136529-001 | -1.9768827828+001 | 7.1287047861+001 |
| -2.1381172519+003 | | | |
| DENSITY = 9.5 | | | |
| -1.6628762469-004 | 1.0340097016+000 | -2.1839611598+001 | 7.1752505542+001 |
| -2.1510413760+003 | | | |
| DENSITY = 10.0 | | | |
| -1.8406316617-004 | 1.1035650202+000 | -2.3956861843+001 | 6.8806216972+001 |
| -2.0853791385+003 | | | |
| DENSITY = 10.5 | | | |
| -2.0281663628-004 | 1.1747759895+000 | -2.6133539628+001 | 6.3005369257+001 |
| -1.9482430327+003 | | | |
| DENSITY = 11.0 | | | |
| -2.2166027077-004 | 1.2472128086+000 | -2.8297966602+001 | 5.0585120801+001 |
| -1.6739112287+003 | | | |
| DENSITY = 11.5 | | | |
| -2.4044928444-004 | 1.3208187953+000 | -3.0432582623+001 | 3.0675323653+001 |
| -1.2476121362+003 | | | |
| DENSITY = 12.0 | | | |
| -2.5967662789-004 | 1.3959153104+000 | -3.2579537251+001 | 5.7436924150+000 |
| -7.1412208830+002 | | | |

TABLE III. PARAMETERS USED IN EQUATIONS (3), WITH P IN ATMOSPHERES, T IN KELVINS

| | | | |
|---|---|---|---|
| DENSITY = 12.5 | | | |
| -2.7918357967-004 | 1.4722853870+000 | -3.4680906805+001 | -2.7772007371+001 |
| -6.1037073737+000 | | | |
| DENSITY = 13.0 | | | |
| -2.9777461516-004 | 1.5495290307+000 | -3.6685447966+001 | -7.1822131921+001 |
| 9.0049463026+002 | | | |
| DENSITY = 13.5 | | | |
| -3.1605166459-004 | 1.6278862572+000 | -3.8613579542+001 | -1.2525881061+002 |
| 1.9832367622+003 | | | |
| DENSITY = 14.0 | | | |
| -3.3204868781-004 | 1.7064927083+000 | -4.0335172103+001 | -1.9461489701+002 |
| 3.3501531897+003 | | | |
| DENSITY = 14.5 | | | |
| -3.4864900231-004 | 1.7866512877+000 | -4.2014584333+001 | -2.7143927277+002 |
| 4.8574584515+003 | | | |
| DENSITY = 15.0 | | | |
| -3.6286133800-004 | 1.8671292494+000 | -4.3489711873+001 | -3.6302893837+002 |
| 6.6131573431+003 | | | |
| DENSITY = 15.5 | | | |
| -3.7652194243-004 | 1.9486140659+000 | -4.4825812174+001 | -4.6639488299+002 |
| 8.5690768140+003 | | | |
| DENSITY = 16.0 | | | |
| -3.9100330874-004 | 2.0318440570+000 | -4.6124333611+001 | -5.7563349879+002 |
| 1.0615910309+004 | | | |
| DENSITY = 16.5 | | | |
| -4.0694793565-004 | 2.1170981674+000 | -4.7411338208+001 | -6.8915329640+002 |
| 1.2721817915+004 | | | |
| DENSITY = 17.0 | | | |
| -4.2678358720-004 | 2.2055136732+000 | -4.8837369723+001 | -7.9860799256+002 |
| 1.4737172571+004 | | | |
| DENSITY = 17.5 | | | |
| -4.5129002783-004 | 2.2974534329+000 | -5.0440187644+001 | -9.0187925049+002 |
| 1.6623968680+004 | | | |
| DENSITY = 18.0 | | | |
| -4.8092247617-004 | 2.3930439609+000 | -5.2209334753+001 | -9.9939387760+002 |
| 1.8384625906+004 | | | |

TABLE III. PARAMETERS USED IN EQUATIONS (3), WITH P IN ATMOSPHERES, T IN KELVINS

| | | | |
|---|---|---|---|
| DENSITY = 18.5 | | | |
| -5.1662927605-004 | 2.4929175099+000 | -5.4252622222+001 | -1.0844076794+003 |
| 1.9895090407+004 | | | |
| DENSITY = 19.0 | | | |
| -5.6026091605-004 | 2.5977551126+000 | -5.6620537258+001 | -1.1548393399+003 |
| 2.1124027606+004 | | | |
| DENSITY = 19.5 | | | |
| -6.0869367563-004 | 2.7061903277+000 | -5.9122678866+001 | -1.2194874530+003 |
| 2.2208351187+004 | | | |
| DENSITY = 20.0 | | | |
| -6.6464806264-004 | 2.8195529676+000 | -6.1937710560+001 | -1.2686550257+003 |
| 2.2982552559+004 | | | |
| DENSITY = 20.5 | | | |
| -7.2822975811-004 | 2.9377376776+000 | -6.5011302816+001 | -1.3053997152+003 |
| 2.3500466689+004 | | | |
| DENSITY = 21.0 | | | |
| -7.9590436431-004 | 3.0593081485+000 | -6.8162965927+001 | -1.3373241903+003 |
| 2.3874998505+004 | | | |
| DENSITY = 21.5 | | | |
| -8.6659371504-004 | 3.1836726515+000 | -7.1274100484+001 | -1.3706258429+003 |
| 2.4212836938+004 | | | |
| DENSITY = 22.0 | | | |
| -9.4506387180-004 | 3.3129245139+000 | -7.4611121251+001 | -1.3915502648+003 |
| 2.4289115793+004 | | | |
| DENSITY = 22.5 | | | |
| -1.0254464941-003 | 3.4444448770+000 | -7.7804822046+001 | -1.4180654901+003 |
| 2.4398654675+004 | | | |
| DENSITY = 23.0 | | | |
| -1.1142088279-003 | 3.5809738506+000 | -8.1193235975+001 | -1.4332331763+003 |
| 2.4269517476+004 | | | |
| DENSITY = 23.5 | | | |
| -1.2044517637-003 | 3.7195130539+000 | -8.4364625867+001 | -1.4568058535+003 |
| 2.4224237866+004 | | | |
| DENSITY = 24.0 | | | |
| -1.3056456005-003 | 3.8639972870+000 | -8.7804140092+001 | -1.4648366274+003 |
| 2.3883581627+004 | | | |

TABLE III. PARAMETERS USED IN EQUATIONS (3), WITH P IN ATMOSPHERES, T IN KELVINS

| | | | |
|---|---|---|---|
| DENSITY = 24.5 | | | |
| -1.4118449586-003 | 4.0115588186+000 | -9.1082621401+001 | -1.4788881030+003 |
| 2.3608500067+004 | | | |
| DENSITY = 25.0 | | | |
| -1.5264256169-003 | 4.1638961193+000 | -9.4439672702+001 | -1.4854592999+003 |
| 2.3174332497+004 | | | |
| DENSITY = 25.5 | | | |
| -1.6438495961-003 | 4.3189140826+000 | -9.7603172639+001 | -1.4964420354+003 |
| 2.2766428211+004 | | | |
| DENSITY = 26.0 | | | |
| -1.7674617671-003 | 4.4776596905+000 | -1.0065892913+002 | -1.5079973928+003 |
| 2.2339656459+004 | | | |
| DENSITY = 26.5 | | | |
| -1.8923165270-003 | 4.6385981045+000 | -1.0344091470+002 | -1.5256288954+003 |
| 2.1966370526+004 | | | |
| DENSITY = 27.0 | | | |
| -2.0311078165-003 | 4.8054612690+000 | -1.0627787242+002 | -1.5368689852+003 |
| 2.1499165614+004 | | | |
| DENSITY = 27.5 | | | |
| -2.1724394000-003 | 4.9749360987+000 | -1.0884246334+002 | -1.5530231397+003 |
| 2.1085163319+004 | | | |
| DENSITY = 28.0 | | | |
| -2.3404026908-003 | 5.1539588441+000 | -1.1176839755+002 | -1.5495435076+003 |
| 2.0410494137+004 | | | |
| DENSITY = 28.5 | | | |
| -2.5265859246-003 | 5.3395759942+000 | -1.1469084384+002 | -1.5420544900+003 |
| 1.9717483704+004 | | | |
| DENSITY = 29.0 | | | |
| -2.7506604636-003 | 5.5368370357+000 | -1.1801840046+002 | -1.5161487461+003 |
| 1.8848416196+004 | | | |
| DENSITY = 29.5 | | | |
| -3.0719684173-003 | 5.7627076342+000 | -1.2330299982+002 | -1.4140666331+003 |
| 1.7083226902+004 | | | |
| DENSITY = 30.0 | | | |
| -3.3529624632-003 | 5.9788901308+000 | -1.2706382481+002 | -1.3595079958+003 |
| 1.5946552995+004 | | | |

TABLE III. PARAMETERS USED IN EQUATIONS (3), WITH P IN ATMOSPHERES, T IN KELVINS

| | | | |
|---|---|---|---|
| DENSITY = 30.5 | | | |
| -3.6886223750-003 | 6.2105404644+000 | -1.3145149633+002 | -1.2776734018+003 |
| 1.4557620546+004 | | | |
| DENSITY = 31.0 | | | |
| -4.1451173488-003 | 6.4748422528+000 | -1.3787294982+002 | -1.1220867633+003 |
| 1.2411705580+004 | | | |
| DENSITY = 31.5 | | | |
| -4.5989647572-003 | 6.7381078753+000 | -1.4332429298+002 | -9.9615977609+002 |
| 1.0735620242+004 | | | |
| DENSITY = 32.0 | | | |
| -5.0913908298-003 | 7.0108340831+000 | -1.4865992838+002 | -8.7048409069+002 |
| 9.1945146758+003 | | | |
| DENSITY = 32.5 | | | |
| -5.4183373440-003 | 7.2448843864+000 | -1.5019535043+002 | -8.5378432591+002 |
| 8.8850152588+003 | | | |
| DENSITY = 33.0 | | | |
| -5.7272313747-003 | 7.4763626986+000 | -1.5077566948+002 | -8.5592197308+002 |
| 8.8481730109+003 | | | |
| DENSITY = 33.5 | | | |
| -6.0178344832-003 | 7.7059714334+000 | -1.5050950969+002 | -8.6936716044+002 |
| 8.9658721604+003 | | | |
| DENSITY = 34.0 | | | |
| -6.2907160416-003 | 7.9342801176+000 | -1.4945335898+002 | -8.9018782398+002 |
| 9.1876411433+003 | | | |
| DENSITY = 34.5 | | | |
| -6.5910430508-003 | 8.1722251405+000 | -1.4845966436+002 | -8.9034620468+002 |
| 9.2177457870+003 | | | |
| DENSITY = 35.0 | | | |
| -6.9613538388-003 | 8.4297028668+000 | -1.4826905949+002 | -8.4592077499+002 |
| 8.8094985045+003 | | | |
| DENSITY = 35.5 | | | |
| -7.5003011209-003 | 8.7248357718+000 | -1.4990641342+002 | -7.3373888901+002 |
| 7.8065751133+003 | | | |
| DENSITY = 36.0 | | | |
| -8.1325053971-003 | 9.0417693036+000 | -1.5227573599+002 | -5.8182463568+002 |
| 6.4633243029+003 | | | |

TABLE III. PARAMETERS USED IN EQUATIONS (3), WITH P IN ATMOSPHERES, T IN KELVINS

| | | | |
|---|---|---|---|
| DENSITY = 36.5 | | | |
| -8.8717791259-003 | 9.3798354063+000 | -1.5505645275+002 | -4.0410495824+002 |
| 4.9608079265+003 | | | |
| DENSITY = 37.0 | | | |
| -9.6788862967-003 | 9.7325335485+000 | -1.5790233941+002 | -2.0575755133+002 |
| 3.3227862365+003 | | | |
| DENSITY = 37.5 | | | |
| -1.0511037493-002 | 1.0093206023+001 | -1.6046136798+002 | 6.5460022949+000 |
| 1.6142950629+003 | | | |
| DENSITY = 38.0 | | | |
| -1.1625105121-002 | 1.0503637936+001 | -1.6484889204+002 | 2.7439908482+002 |
| -4.1452110643+002 | | | |
| DENSITY = 38.5 | | | |
| -1.2233295531-002 | 1.0809519817+001 | -1.6114807693+002 | 3.5204600243+002 |
| -7.4622608285+002 | | | |
| DENSITY = 39.0 | | | |
| -1.2845705646-002 | 1.1107299550+001 | -1.5540630418+002 | 3.9174368978+002 |
| -6.6609064097+002 | | | |
| DENSITY = 39.5 | | | |
| -1.3051621429-002 | 1.1341373749+001 | -1.4545735257+002 | 3.6900397649+002 |
| -1.5025754560+002 | | | |
| DENSITY = 40.0 | | | |
| -1.3422778913-002 | 1.1602672392+001 | -1.3600730390+002 | 3.8197790412+002 |
| 1.1007715102+002 | | | |

Table IV. Parameters for Equation (4), for T in K and $\rho$ in $mol/cm^3$.

| | |
|---|---|
| $A_1$ | 1.3902 9009 18 |
| $A_2$ | $-1.8543\ 3546\ 54 \times 10^2$ |
| $A_3$ | $2.9602\ 3725\ 60 \times 10^3$ |
| $A_4$ | $-2.0125\ 2307\ 80 \times 10^3$ |
| $A_5$ | $-1.0175\ 8396\ 61 \times 10^2$ |
| $A_6$ | $1.3356\ 9761\ 21 \times 10^4$ |
| $A_7$ | $-1.7573\ 1404\ 86 \times 10^5$ |
| $A_8$ | $7.7488\ 2413\ 51 \times 10^4$ |
| $A_9$ | $-1.2636\ 6439\ 24 \times 10^5$ |
| $A_{10}$ | $2.4661\ 1537\ 96 \times 10^3$ |
| $A_{11}$ | $-3.1417\ 2527\ 76 \times 10^5$ |
| $A_{12}$ | $2.4375\ 4908\ 01 \times 10^6$ |
| $A_{13}$ | $-2.0047\ 3646\ 67 \times 10^4$ |
| $A_{14}$ | $2.5432\ 6216\ 67 \times 10^6$ |
| R | 82.0597 |

TABLE V. THERMODYNAMIC PROPERTIES OF PARAHYDROGEN ON THE LIQUID-VAPOR BOUNDARY

| TEMPERATURE DEG K | PRESSURE BAR | MOLAR VOLUME $CM^3/G$ | INTERNAL ENERGY J/G | ENTHALPY J/G | ENTROPY J/G - K | SPECIFIC HEAT CV J/G - K | SPECIFIC HEAT CP J/G - K | VELOCITY OF SOUND M/SEC | $\left(\frac{\partial P}{\partial T}\right)_V$ BAR/K | $\left(\frac{\partial P}{\partial \rho}\right)_T$ BAR-$CM^3$/G |
|---|---|---|---|---|---|---|---|---|---|---|
| 13.803 | 0.070 | 12.98 | -309.0 | -308.9 | 4.97 | 4.67 | 6.37 | 1264 | 9.23 | 11725 |
| 13.803 | 0.070 | 7965.79 | 84.2 | 140.3 | 37.52 | 6.21 | 10.52 | 306 | 0.01 | 552 |
| 14.000 | 0.079 | 13.01 | -307.7 | -307.6 | 5.06 | 4.72 | 6.47 | 1256 | 9.23 | 11493 |
| 14.000 | 0.079 | 7203.09 | 85.3 | 142.1 | 37.19 | 6.21 | 10.54 | 308 | 0.01 | 558 |
| 15.000 | 0.134 | 13.16 | -300.9 | -300.7 | 5.53 | 4.92 | 6.91 | 1228 | 9.16 | 10737 |
| 15.000 | 0.134 | 4489.45 | 90.7 | 151.1 | 35.65 | 6.24 | 10.67 | 317 | 0.01 | 588 |
| 16.000 | 0.216 | 13.32 | -293.7 | -293.4 | 5.99 | 5.12 | 7.36 | 1200 | 8.89 | 10028 |
| 16.000 | 0.216 | 2954.52 | 95.9 | 159.6 | 34.31 | 6.28 | 10.85 | 326 | 0.01 | 615 |
| 17.000 | 0.329 | 13.48 | -286.1 | -285.6 | 6.45 | 5.30 | 7.88 | 1168 | 8.75 | 9177 |
| 17.000 | 0.329 | 2032.06 | 100.7 | 167.6 | 33.11 | 6.32 | 11.07 | 334 | 0.02 | 637 |
| 18.000 | 0.482 | 13.66 | -278.0 | -277.3 | 6.92 | 5.47 | 8.42 | 1140 | 8.61 | 8442 |
| 18.000 | 0.482 | 1449.03 | 105.1 | 175.0 | 32.05 | 6.37 | 11.34 | 341 | 0.03 | 654 |
| 19.000 | 0.682 | 13.86 | -269.4 | -268.4 | 7.38 | 5.62 | 8.93 | 1120 | 8.46 | 7894 |
| 19.000 | 0.682 | 1064.57 | 109.1 | 181.7 | 31.08 | 6.43 | 11.66 | 348 | 0.04 | 667 |
| 20.000 | 0.935 | 14.07 | -260.2 | -258.9 | 7.85 | 5.75 | 9.45 | 1100 | 8.30 | 7365 |
| 20.000 | 0.935 | 801.74 | 112.7 | 187.7 | 30.19 | 6.49 | 12.05 | 354 | 0.05 | 674 |
| 20.268 | 1.013 | 14.13 | -257.7 | -256.3 | 7.98 | 5.78 | 9.66 | 1089 | 8.25 | 7094 |
| 20.268 | 1.013 | 747.55 | 113.6 | 189.3 | 29.97 | 6.51 | 12.15 | 355 | 0.06 | 675 |
| 21.000 | 1.250 | 14.30 | -250.6 | -248.8 | 8.32 | 5.86 | 10.13 | 1070 | 8.12 | 6620 |
| 21.000 | 1.250 | 617.79 | 115.8 | 193.0 | 29.37 | 6.55 | 12.49 | 359 | 0.07 | 675 |
| 22.000 | 1.634 | 14.55 | -240.3 | -237.9 | 8.80 | 5.95 | 10.82 | 1044 | 7.91 | 5994 |
| 22.000 | 1.634 | 482.90 | 118.3 | 197.3 | 28.60 | 6.61 | 13.03 | 363 | 0.09 | 670 |
| 23.000 | 2.096 | 14.84 | -229.4 | -226.3 | 9.29 | 6.03 | 11.69 | 1010 | 7.67 | 5264 |
| 23.000 | 2.096 | 382.90 | 120.2 | 200.5 | 27.86 | 6.68 | 13.69 | 367 | 0.12 | 658 |
| 24.000 | 2.645 | 15.15 | -217.9 | -213.9 | 9.78 | 6.09 | 12.52 | 980 | 7.39 | 4675 |
| 24.000 | 2.645 | 307.27 | 121.4 | 202.7 | 27.15 | 6.74 | 14.50 | 371 | 0.15 | 639 |
| 25.000 | 3.288 | 15.51 | -205.5 | -200.4 | 10.29 | 6.14 | 13.44 | 948 | 7.06 | 4109 |
| 25.000 | 3.288 | 248.97 | 121.7 | 203.6 | 26.46 | 6.81 | 15.52 | 373 | 0.19 | 613 |
| 26.000 | 4.035 | 15.92 | -192.4 | -185.9 | 10.81 | 6.20 | 14.81 | 903 | 6.68 | 3410 |
| 26.000 | 4.035 | 203.21 | 121.1 | 203.1 | 25.79 | 6.90 | 16.86 | 376 | 0.23 | 578 |
| 27.000 | 4.892 | 16.39 | -178.2 | -170.2 | 11.36 | 6.26 | 16.18 | 860 | 6.25 | 2858 |
| 27.000 | 4.892 | 166.69 | 119.3 | 200.9 | 25.11 | 6.99 | 18.67 | 377 | 0.29 | 534 |
| 28.000 | 5.871 | 16.96 | -162.8 | -152.9 | 11.93 | 6.33 | 18.48 | 806 | 5.79 | 2225 |
| 28.000 | 5.871 | 137.04 | 116.1 | 196.5 | 24.41 | 7.12 | 21.24 | 378 | 0.36 | 479 |
| 29.000 | 6.978 | 17.66 | -145.9 | -133.6 | 12.54 | 6.41 | 22.05 | 747 | 5.30 | 1624 |
| 29.000 | 6.978 | 112.54 | 111.0 | 189.5 | 23.68 | 7.28 | 25.20 | 378 | 0.45 | 414 |
| 30.000 | 8.225 | 18.54 | -127.0 | -111.7 | 13.20 | 6.51 | 26.59 | 689 | 4.76 | 1164 |
| 30.000 | 8.225 | 91.86 | 103.2 | 178.8 | 22.89 | 7.50 | 32.00 | 378 | 0.57 | 334 |
| 31.000 | 9.627 | 19.77 | -104.9 | -85.8 | 13.96 | 6.66 | 36.55 | 619 | 4.15 | 698 |
| 31.000 | 9.627 | 73.86 | 91.5 | 162.6 | 21.98 | 7.82 | 46.57 | 375 | 0.74 | 237 |
| 32.000 | 11.198 | 21.74 | -76.8 | -52.4 | 14.92 | 6.91 | 65.38 | 534 | 3.42 | 302 |
| 32.000 | 11.198 | 57.15 | 72.1 | 136.1 | 20.81 | 8.12 | 87.03 | 372 | 0.99 | 129 |
| 32.976 | 12.928 | 31.82 | -2.8 | 38.3 | 17.57 | | | | 1.90 | |
| 32.976 | 12.928 | 31.82 | -3.1 | 38.1 | 17.56 | | | | 1.90 | |

TABLE VI. THERMODYNAMIC PROPERTIES OF PARAHYDROGEN

| | 1 BAR ISOBAR TEMPERATURE K | MOLAR VOLUME $CM^3/G$ | INTERNAL ENERGY J/G | ENTHALPY J/G | ENTROPY J/G-K | SPECIFIC HEAT CV J/G-K | SPECIFIC HEAT CP J/G-K | VELOCITY OF SOUND M/S | $\left(\frac{\partial P}{\partial T}\right)_V$ BAR/K | $\left(\frac{\partial P}{\partial \rho}\right)_T$ BAR-$CM^3$/G |
|---|---|---|---|---|---|---|---|---|---|---|
| * | 13.834 | 12.98 | -308.9 | -307.6 | 4.97 | 4.68 | 6.38 | 1262 | 9.24 | 11686 |
| | 14 | 13.00 | -307.8 | -306.5 | 5.05 | 4.71 | 6.48 | 1254 | 9.24 | 11443 |
| | 15 | 13.14 | -301.2 | -299.8 | 5.51 | 4.92 | 6.98 | 1216 | 9.10 | 10410 |
| | 16 | 13.30 | -294.0 | -292.6 | 5.97 | 5.12 | 7.43 | 1190 | 8.93 | 9750 |
| | 17 | 13.47 | -286.3 | -284.9 | 6.44 | 5.30 | 7.91 | 1166 | 8.77 | 9113 |
| | 18 | 13.65 | -278.1 | -276.8 | 6.91 | 5.47 | 8.41 | 1143 | 8.63 | 8502 |
| | 19 | 13.85 | -269.5 | -268.1 | 7.38 | 5.62 | 8.95 | 1119 | 8.48 | 7854 |
| | 20 | 14.07 | -260.3 | -258.9 | 7.85 | 5.75 | 9.53 | 1094 | 8.30 | 7222 |
| * | 20.224 | 14.12 | -258.1 | -256.7 | 7.96 | 5.77 | 9.64 | 1090 | 8.26 | 7122 |
| * | 20.224 | 754.62 | 113.4 | 188.9 | 30.00 | 6.50 | 12.14 | 355 | 0.06 | 675 |
| | 21 | 791.87 | 119.0 | 198.2 | 30.45 | 6.43 | 11.86 | 364 | 0.05 | 717 |
| | 22 | 838.92 | 126.0 | 209.9 | 30.99 | 6.37 | 11.60 | 375 | 0.05 | 771 |
| | 23 | 885.17 | 132.9 | 221.4 | 31.51 | 6.33 | 11.41 | 385 | 0.05 | 822 |
| | 24 | 930.78 | 139.7 | 232.8 | 31.99 | 6.30 | 11.27 | 395 | 0.05 | 872 |
| | 25 | 975.89 | 146.4 | 244.0 | 32.45 | 6.29 | 11.16 | 404 | 0.04 | 921 |
| | 26 | 1020.59 | 153.0 | 255.1 | 32.88 | 6.27 | 11.07 | 413 | 0.04 | 969 |
| | 27 | 1064.95 | 159.6 | 266.1 | 33.30 | 6.26 | 10.99 | 422 | 0.04 | 1017 |
| | 28 | 1109.02 | 166.2 | 277.1 | 33.70 | 6.26 | 10.93 | 431 | 0.04 | 1063 |
| | 29 | 1152.83 | 172.7 | 288.0 | 34.08 | 6.25 | 10.88 | 439 | 0.04 | 1110 |
| | 30 | 1196.43 | 179.2 | 298.8 | 34.45 | 6.25 | 10.83 | 448 | 0.04 | 1156 |
| | 31 | 1239.84 | 185.7 | 309.7 | 34.80 | 6.24 | 10.79 | 456 | 0.03 | 1201 |
| | 32 | 1283.08 | 192.1 | 320.4 | 35.14 | 6.24 | 10.75 | 463 | 0.03 | 1246 |
| | 33 | 1326.17 | 198.5 | 331.2 | 35.47 | 6.23 | 10.72 | 471 | 0.03 | 1291 |
| | 34 | 1369.13 | 205.0 | 341.9 | 35.79 | 6.23 | 10.69 | 479 | 0.03 | 1336 |
| | 35 | 1411.97 | 211.3 | 352.5 | 36.10 | 6.23 | 10.66 | 486 | 0.03 | 1380 |
| | 36 | 1454.70 | 217.7 | 363.2 | 36.40 | 6.23 | 10.64 | 493 | 0.03 | 1425 |
| | 37 | 1497.34 | 224.1 | 373.8 | 36.69 | 6.23 | 10.62 | 501 | 0.03 | 1469 |
| | 38 | 1539.89 | 230.5 | 384.4 | 36.98 | 6.22 | 10.60 | 508 | 0.03 | 1513 |
| | 39 | 1582.36 | 236.8 | 395.0 | 37.25 | 6.22 | 10.59 | 514 | 0.03 | 1556 |
| | 40 | 1624.76 | 243.1 | 405.6 | 37.52 | 6.22 | 10.58 | 521 | 0.03 | 1600 |
| | 42 | 1709.36 | 255.8 | 426.8 | 38.04 | 6.23 | 10.55 | 535 | 0.02 | 1686 |
| | 44 | 1793.75 | 268.5 | 447.8 | 38.53 | 6.23 | 10.54 | 547 | 0.02 | 1773 |
| | 46 | 1877.94 | 281.1 | 468.9 | 38.99 | 6.25 | 10.53 | 560 | 0.02 | 1859 |
| | 48 | 1961.97 | 293.8 | 490.0 | 39.44 | 6.26 | 10.53 | 572 | 0.02 | 1944 |
| | 50 | 2045.86 | 306.5 | 511.1 | 39.87 | 6.28 | 10.54 | 583 | 0.02 | 2029 |
| | 55 | 2255.09 | 338.4 | 563.9 | 40.88 | 6.37 | 10.60 | 611 | 0.02 | 2242 |
| | 60 | 2463.76 | 370.8 | 617.2 | 41.81 | 6.50 | 10.71 | 636 | 0.02 | 2453 |
| | 65 | 2672.01 | 403.9 | 671.1 | 42.67 | 6.69 | 10.89 | 658 | 0.02 | 2663 |
| | 70 | 2879.94 | 438.2 | 726.2 | 43.49 | 6.94 | 11.13 | 679 | 0.01 | 2872 |
| | 75 | 3087.63 | 473.8 | 782.5 | 44.26 | 7.25 | 11.42 | 697 | 0.01 | 3082 |
| | 80 | 3295.11 | 511.0 | 840.5 | 45.01 | 7.60 | 11.77 | 714 | 0.01 | 3290 |
| | 85 | 3502.44 | 550.1 | 900.3 | 45.74 | 7.99 | 12.16 | 729 | 0.01 | 3499 |
| | 90 | 3709.64 | 591.1 | 962.1 | 46.44 | 8.41 | 12.57 | 744 | 0.01 | 3707 |
| | 95 | 3916.72 | 634.3 | 1026.0 | 47.13 | 8.84 | 13.00 | 759 | 0.01 | 3915 |
| | 100 | 4123.72 | 679.7 | 1092.1 | 47.81 | 9.28 | 13.43 | 773 | 0.01 | 4123 |
| | 110 | 4537.48 | 776.7 | 1230.5 | 49.13 | 10.10 | 14.25 | 800 | 0.01 | 4538 |
| | 120 | 4951.00 | 881.6 | 1376.7 | 50.40 | 10.83 | 14.97 | 827 | 0.01 | 4952 |
| | 130 | 5364.35 | 993.0 | 1529.4 | 51.62 | 11.40 | 15.54 | 855 | 0.01 | 5366 |
| | 140 | 5777.57 | 1109.3 | 1687.1 | 52.79 | 11.82 | 15.96 | 883 | 0.01 | 5780 |
| | 150 | 6190.68 | 1229.0 | 1848.1 | 53.90 | 12.09 | 16.22 | 912 | 0.01 | 6194 |
| | 160 | 6603.70 | 1350.7 | 2011.0 | 54.95 | 12.21 | 16.35 | 940 | 0.01 | 6608 |
| | 170 | 7016.65 | 1473.0 | 2174.7 | 55.95 | 12.24 | 16.37 | 969 | 0.01 | 7021 |
| | 180 | 7429.54 | 1595.3 | 2338.2 | 56.88 | 12.19 | 16.32 | 998 | 0.01 | 7434 |
| | 190 | 7842.38 | 1716.7 | 2501.0 | 57.76 | 12.08 | 16.21 | 1026 | 0.01 | 7847 |
| | 200 | 8255.19 | 1836.9 | 2662.4 | 58.59 | 11.95 | 16.08 | 1054 | 0.01 | 8261 |
| | 220 | 9080.69 | 2072.8 | 2980.8 | 60.11 | 11.63 | 15.76 | 1110 | 0.00 | 9087 |
| | 240 | 9906.10 | 2302.4 | 3293.0 | 61.46 | 11.33 | 15.46 | 1163 | 0.00 | 9912 |
| | 260 | 10731.43 | 2526.4 | 3599.5 | 62.69 | 11.07 | 15.20 | 1214 | 0.00 | 10738 |
| | 280 | 11556.70 | 2745.8 | 3901.5 | 63.81 | 10.87 | 15.00 | 1263 | 0.00 | 11564 |
| | 300 | 12381.92 | 2961.7 | 4199.9 | 64.84 | 10.72 | 14.85 | 1310 | 0.00 | 12389 |

* TWO PHASE BOUNDARY

TABLE VI. THERMODYNAMIC PROPERTIES OF PARAHYDROGEN

| | TEMPERATURE K | MOLAR VOLUME CM³/G | INTERNAL ENERGY J/G | ENTHALPY J/G | ENTROPY J/G-K | SPECIFIC HEAT CV J/G-K | SPECIFIC HEAT CP J/G-K | VELOCITY OF SOUND M/S | $\left(\frac{\partial P}{\partial T}\right)_V$ BAR/K | $\left(\frac{\partial P}{\partial \rho}\right)_T$ BAR-CM³/G |
|---|---|---|---|---|---|---|---|---|---|---|
| | 2 BAR ISOBAR | | | | | | | | | |
| * | 13.868 | 12.97 | -308.9 | -306.3 | 4.97 | 4.69 | 6.38 | 1265 | 9.26 | 11750 |
| | 14 | 12.99 | -308.0 | -305.4 | 5.03 | 4.71 | 6.46 | 1260 | 9.25 | 11598 |
| | 15 | 13.13 | -301.4 | -298.7 | 5.49 | 4.91 | 6.97 | 1221 | 9.14 | 10514 |
| | 16 | 13.28 | -294.2 | -291.5 | 5.96 | 5.11 | 7.41 | 1195 | 8.96 | 9848 |
| | 17 | 13.45 | -286.6 | -283.9 | 6.42 | 5.30 | 7.89 | 1171 | 8.81 | 9210 |
| | 18 | 13.63 | -278.5 | -275.7 | 6.89 | 5.46 | 8.38 | 1149 | 8.66 | 8604 |
| | 19 | 13.83 | -269.9 | -267.1 | 7.36 | 5.61 | 8.92 | 1124 | 8.51 | 7953 |
| | 20 | 14.04 | -260.7 | -257.9 | 7.83 | 5.74 | 9.48 | 1100 | 8.34 | 7324 |
| | 21 | 14.28 | -251.0 | -248.1 | 8.30 | 5.86 | 10.12 | 1073 | 8.15 | 6662 |
| | 22 | 14.54 | -240.6 | -237.7 | 8.79 | 5.95 | 10.83 | 1044 | 7.93 | 5996 |
| * | 22.805 | 14.78 | -231.6 | -228.7 | 9.19 | 6.02 | 11.52 | 1017 | 7.72 | 5396 |
| * | 22.805 | 400.19 | 119.9 | 199.9 | 28.00 | 6.67 | 13.55 | 367 | 0.11 | 661 |
| | 23 | 405.36 | 121.5 | 202.6 | 28.11 | 6.64 | 13.41 | 369 | 0.11 | 674 |
| | 24 | 431.62 | 129.3 | 215.7 | 28.67 | 6.52 | 12.84 | 381 | 0.10 | 738 |
| | 25 | 457.01 | 136.9 | 228.3 | 29.19 | 6.45 | 12.44 | 392 | 0.10 | 799 |
| | 26 | 481.75 | 144.2 | 240.6 | 29.67 | 6.40 | 12.15 | 403 | 0.09 | 856 |
| | 27 | 505.99 | 151.4 | 252.6 | 30.12 | 6.37 | 11.92 | 413 | 0.09 | 912 |
| | 28 | 529.82 | 158.5 | 264.4 | 30.55 | 6.35 | 11.74 | 423 | 0.08 | 966 |
| | 29 | 553.32 | 165.4 | 276.1 | 30.96 | 6.33 | 11.59 | 432 | 0.08 | 1019 |
| | 30 | 576.53 | 172.3 | 287.6 | 31.35 | 6.32 | 11.47 | 441 | 0.07 | 1070 |
| | 31 | 599.51 | 179.1 | 299.0 | 31.73 | 6.30 | 11.36 | 449 | 0.07 | 1121 |
| | 32 | 622.28 | 185.9 | 310.4 | 32.09 | 6.30 | 11.27 | 458 | 0.07 | 1170 |
| | 33 | 644.88 | 192.6 | 321.6 | 32.43 | 6.29 | 11.19 | 466 | 0.07 | 1220 |
| | 34 | 667.32 | 199.3 | 332.7 | 32.76 | 6.29 | 11.12 | 474 | 0.06 | 1268 |
| | 35 | 689.62 | 205.9 | 343.8 | 33.09 | 6.27 | 11.06 | 482 | 0.06 | 1316 |
| | 36 | 711.80 | 212.5 | 354.9 | 33.40 | 6.27 | 11.01 | 489 | 0.06 | 1363 |
| | 37 | 733.88 | 219.1 | 365.9 | 33.70 | 6.26 | 10.96 | 497 | 0.06 | 1410 |
| | 38 | 755.86 | 225.6 | 376.8 | 33.99 | 6.26 | 10.92 | 504 | 0.06 | 1457 |
| | 39 | 777.75 | 232.1 | 387.7 | 34.27 | 6.25 | 10.88 | 511 | 0.05 | 1503 |
| | 40 | 799.56 | 238.6 | 398.6 | 34.55 | 6.25 | 10.85 | 518 | 0.05 | 1549 |
| | 42 | 842.98 | 251.6 | 420.2 | 35.08 | 6.25 | 10.79 | 532 | 0.05 | 1640 |
| | 44 | 886.16 | 264.5 | 441.7 | 35.58 | 6.26 | 10.75 | 545 | 0.05 | 1730 |
| | 46 | 929.14 | 277.4 | 463.2 | 36.05 | 6.27 | 10.72 | 558 | 0.05 | 1820 |
| | 48 | 971.95 | 290.3 | 484.7 | 36.51 | 6.28 | 10.71 | 570 | 0.04 | 1908 |
| | 50 | 1014.61 | 303.1 | 506.1 | 36.95 | 6.30 | 10.70 | 582 | 0.04 | 1996 |
| | 55 | 1120.75 | 335.4 | 559.6 | 37.97 | 6.38 | 10.72 | 610 | 0.04 | 2215 |
| | 60 | 1226.31 | 368.1 | 613.4 | 38.90 | 6.51 | 10.81 | 635 | 0.03 | 2431 |
| | 65 | 1331.45 | 401.5 | 667.8 | 39.78 | 6.70 | 10.97 | 658 | 0.03 | 2645 |
| | 70 | 1436.26 | 436.0 | 723.2 | 40.60 | 6.95 | 11.20 | 679 | 0.03 | 2858 |
| | 75 | 1540.82 | 471.8 | 779.9 | 41.38 | 7.25 | 11.48 | 697 | 0.03 | 3070 |
| | 80 | 1645.19 | 509.1 | 838.2 | 42.13 | 7.60 | 11.82 | 714 | 0.03 | 3281 |
| | 85 | 1749.39 | 548.3 | 898.2 | 42.86 | 7.99 | 12.20 | 730 | 0.02 | 3492 |
| | 90 | 1853.46 | 589.5 | 960.2 | 43.57 | 8.41 | 12.61 | 745 | 0.02 | 3702 |
| | 95 | 1957.42 | 632.8 | 1024.3 | 44.26 | 8.84 | 13.03 | 759 | 0.02 | 3911 |
| | 100 | 2061.29 | 678.3 | 1090.6 | 44.94 | 9.28 | 13.46 | 773 | 0.02 | 4120 |
| | 110 | 2268.80 | 775.5 | 1229.3 | 46.26 | 10.11 | 14.28 | 801 | 0.02 | 4538 |
| | 120 | 2476.07 | 880.5 | 1375.7 | 47.53 | 10.83 | 14.99 | 828 | 0.02 | 4954 |
| | 130 | 2683.18 | 992.0 | 1528.6 | 48.76 | 11.41 | 15.56 | 856 | 0.02 | 5370 |
| | 140 | 2890.14 | 1108.4 | 1686.4 | 49.93 | 11.82 | 15.97 | 884 | 0.01 | 5786 |
| | 150 | 3097.00 | 1228.2 | 1847.6 | 51.04 | 12.08 | 16.23 | 913 | 0.01 | 6201 |
| | 160 | 3303.77 | 1349.9 | 2010.6 | 52.09 | 12.21 | 16.36 | 941 | 0.01 | 6615 |
| | 170 | 3510.47 | 1472.3 | 2174.4 | 53.08 | 12.24 | 16.38 | 970 | 0.01 | 7030 |
| | 180 | 3717.12 | 1594.6 | 2338.0 | 54.02 | 12.19 | 16.33 | 999 | 0.01 | 7444 |
| | 190 | 3923.71 | 1716.1 | 2500.8 | 54.90 | 12.08 | 16.22 | 1027 | 0.01 | 7858 |
| | 200 | 4130.27 | 1836.3 | 2662.4 | 55.73 | 11.95 | 16.08 | 1055 | 0.01 | 8271 |
| | 220 | 4543.28 | 2072.3 | 2980.9 | 57.24 | 11.63 | 15.77 | 1110 | 0.01 | 9098 |
| | 240 | 4956.19 | 2301.9 | 3293.2 | 58.60 | 11.33 | 15.46 | 1164 | 0.01 | 9925 |
| | 260 | 5369.03 | 2526.0 | 3599.8 | 59.83 | 11.08 | 15.21 | 1215 | 0.01 | 10751 |
| | 280 | 5781.80 | 2745.4 | 3901.8 | 60.95 | 10.87 | 15.00 | 1264 | 0.01 | 11577 |
| | 300 | 6194.53 | 2961.3 | 4200.2 | 61.98 | 10.72 | 14.85 | 1311 | 0.01 | 12403 |

* TWO PHASE BOUNDARY

TABLE VI. THERMODYNAMIC PROPERTIES OF PARAHYDROGEN

| | 3 BAR ISOBAR TEMPERATURE K | MOLAR VOLUME $CM^3/G$ | INTERNAL ENERGY J/G | ENTHALPY J/G | ENTROPY J/G-K | SPECIFIC HEAT CV J/G-K | SPECIFIC HEAT CP J/G-K | VELOCITY OF SOUND M/S | $\left(\frac{\partial P}{\partial T}\right)_V$ BAR/K | $\left(\frac{\partial P}{\partial \rho}\right)_T$ BAR-$CM^3/G$ |
|---|---|---|---|---|---|---|---|---|---|---|
| * | 13.901 | 12.96 | -308.9 | -305.0 | 4.97 | 4.69 | 6.39 | 1268 | 9.27 | 11814 |
| | 14 | 12.97 | -308.2 | -304.3 | 5.02 | 4.71 | 6.43 | 1267 | 9.27 | 11751 |
| | 15 | 13.11 | -301.6 | -297.6 | 5.48 | 4.91 | 6.96 | 1226 | 9.18 | 10617 |
| | 16 | 13.27 | -294.4 | -290.5 | 5.94 | 5.11 | 7.40 | 1200 | 8.99 | 9946 |
| | 17 | 13.43 | -286.9 | -282.8 | 6.41 | 5.29 | 7.87 | 1176 | 8.84 | 9306 |
| | 18 | 13.61 | -278.8 | -274.7 | 6.87 | 5.46 | 8.35 | 1154 | 8.69 | 8704 |
| | 19 | 13.80 | -270.2 | -266.1 | 7.34 | 5.61 | 8.89 | 1130 | 8.54 | 8052 |
| | 20 | 14.01 | -261.2 | -257.0 | 7.80 | 5.74 | 9.44 | 1105 | 8.37 | 7424 |
| | 21 | 14.25 | -251.5 | -247.2 | 8.28 | 5.85 | 10.06 | 1079 | 8.18 | 6766 |
| | 22 | 14.50 | -241.2 | -236.8 | 8.76 | 5.95 | 10.75 | 1051 | 7.96 | 6107 |
| | 23 | 14.80 | -230.1 | -225.6 | 9.26 | 6.03 | 11.56 | 1019 | 7.71 | 5414 |
| | 24 | 15.13 | -218.2 | -213.6 | 9.77 | 6.09 | 12.49 | 983 | 7.41 | 4708 |
| * | 24.571 | 15.35 | -210.9 | -206.3 | 10.07 | 6.12 | 13.04 | 962 | 7.21 | 4346 |
| * | 24.571 | 272.23 | 121.7 | 203.4 | 26.76 | 6.78 | 15.05 | 372 | 0.17 | 625 |
| | 25 | 280.77 | 125.5 | 209.8 | 27.02 | 6.71 | 14.59 | 378 | 0.16 | 658 |
| | 26 | 299.69 | 134.0 | 223.9 | 27.57 | 6.59 | 13.80 | 391 | 0.15 | 730 |
| | 27 | 317.79 | 142.1 | 237.4 | 28.08 | 6.52 | 13.25 | 403 | 0.14 | 797 |
| | 28 | 335.28 | 149.9 | 250.5 | 28.56 | 6.47 | 12.84 | 413 | 0.13 | 861 |
| | 29 | 352.31 | 157.5 | 263.2 | 29.00 | 6.43 | 12.52 | 424 | 0.12 | 921 |
| | 30 | 368.96 | 164.9 | 275.6 | 29.42 | 6.40 | 12.27 | 433 | 0.12 | 980 |
| | 31 | 385.30 | 172.1 | 287.7 | 29.82 | 6.38 | 12.07 | 443 | 0.11 | 1036 |
| | 32 | 401.39 | 179.3 | 299.7 | 30.20 | 6.36 | 11.89 | 452 | 0.11 | 1092 |
| | 33 | 417.27 | 186.3 | 311.5 | 30.56 | 6.35 | 11.75 | 460 | 0.10 | 1145 |
| | 34 | 432.96 | 193.3 | 323.2 | 30.91 | 6.33 | 11.62 | 469 | 0.10 | 1198 |
| | 35 | 448.48 | 200.2 | 334.8 | 31.25 | 6.32 | 11.51 | 477 | 0.10 | 1250 |
| | 36 | 463.88 | 207.1 | 346.2 | 31.57 | 6.31 | 11.42 | 485 | 0.09 | 1301 |
| | 37 | 479.14 | 213.9 | 357.6 | 31.88 | 6.30 | 11.34 | 493 | 0.09 | 1351 |
| | 38 | 494.31 | 220.6 | 368.9 | 32.18 | 6.29 | 11.26 | 501 | 0.09 | 1400 |
| | 39 | 509.37 | 227.3 | 380.1 | 32.48 | 6.29 | 11.20 | 508 | 0.08 | 1449 |
| | 40 | 524.35 | 234.0 | 391.3 | 32.76 | 6.28 | 11.15 | 515 | 0.08 | 1498 |
| | 42 | 554.09 | 247.3 | 413.5 | 33.30 | 6.28 | 11.05 | 530 | 0.08 | 1594 |
| | 44 | 583.57 | 260.5 | 435.5 | 33.81 | 6.28 | 10.98 | 543 | 0.07 | 1688 |
| | 46 | 612.83 | 273.6 | 457.4 | 34.30 | 6.28 | 10.92 | 556 | 0.07 | 1781 |
| | 48 | 641.92 | 286.7 | 479.3 | 34.76 | 6.30 | 10.88 | 569 | 0.07 | 1873 |
| | 50 | 670.86 | 299.7 | 501.0 | 35.21 | 6.31 | 10.86 | 581 | 0.06 | 1964 |
| | 55 | 742.65 | 332.4 | 555.2 | 36.24 | 6.39 | 10.85 | 609 | 0.06 | 2188 |
| | 60 | 813.85 | 365.5 | 609.6 | 37.19 | 6.52 | 10.92 | 635 | 0.05 | 2409 |
| | 65 | 884.62 | 399.1 | 664.5 | 38.07 | 6.71 | 11.06 | 658 | 0.05 | 2627 |
| | 70 | 955.07 | 433.8 | 720.3 | 38.89 | 6.95 | 11.27 | 679 | 0.04 | 2844 |
| | 75 | 1025.25 | 469.7 | 777.3 | 39.68 | 7.26 | 11.54 | 697 | 0.04 | 3058 |
| | 80 | 1095.24 | 507.3 | 835.8 | 40.43 | 7.61 | 11.87 | 715 | 0.04 | 3272 |
| | 85 | 1165.07 | 546.6 | 896.1 | 41.17 | 8.00 | 12.25 | 730 | 0.04 | 3485 |
| | 90 | 1234.76 | 587.9 | 958.4 | 41.88 | 8.42 | 12.65 | 745 | 0.03 | 3697 |
| | 95 | 1304.35 | 631.3 | 1022.6 | 42.57 | 8.85 | 13.07 | 760 | 0.03 | 3908 |
| | 100 | 1373.84 | 676.9 | 1089.0 | 43.25 | 9.23 | 13.49 | 774 | 0.03 | 4118 |
| | 110 | 1512.59 | 774.2 | 1229.0 | 44.57 | 10.11 | 14.30 | 801 | 0.03 | 4538 |
| | 120 | 1651.12 | 879.4 | 1374.7 | 45.85 | 10.83 | 15.01 | 829 | 0.03 | 4957 |
| | 130 | 1789.46 | 991.0 | 1527.8 | 47.08 | 11.41 | 15.58 | 857 | 0.02 | 5375 |
| | 140 | 1927.68 | 1107.5 | 1685.8 | 48.25 | 11.82 | 15.99 | 885 | 0.02 | 5791 |
| | 150 | 2065.78 | 1227.3 | 1847.1 | 49.36 | 12.09 | 16.24 | 913 | 0.02 | 6207 |
| | 160 | 2203.80 | 1349.1 | 2010.2 | 50.41 | 12.22 | 16.37 | 942 | 0.02 | 6623 |
| | 170 | 2341.76 | 1471.6 | 2174.1 | 51.41 | 12.24 | 16.39 | 971 | 0.02 | 7038 |
| | 180 | 2479.65 | 1593.9 | 2337.8 | 52.34 | 12.19 | 16.34 | 999 | 0.02 | 7453 |
| | 190 | 2617.50 | 1715.5 | 2500.7 | 53.22 | 12.09 | 16.23 | 1028 | 0.02 | 7868 |
| | 200 | 2755.30 | 1835.7 | 2662.3 | 54.05 | 11.95 | 16.09 | 1056 | 0.02 | 8282 |
| | 220 | 3030.82 | 2071.8 | 2981.0 | 55.57 | 11.63 | 15.77 | 1111 | 0.01 | 9110 |
| | 240 | 3306.23 | 2301.5 | 3293.3 | 56.93 | 11.33 | 15.47 | 1165 | 0.01 | 9938 |
| | 260 | 3581.56 | 2525.6 | 3600.0 | 58.16 | 11.08 | 15.21 | 1216 | 0.01 | 10765 |
| | 280 | 3856.84 | 2745.1 | 3902.1 | 59.28 | 10.87 | 15.01 | 1265 | 0.01 | 11591 |
| | 300 | 4132.07 | 2961.0 | 4200.6 | 60.31 | 10.72 | 14.85 | 1311 | 0.01 | 12418 |

* TWO PHASE BOUNDARY

TABLE VI. THERMODYNAMIC PROPERTIES OF PARAHYDROGEN

| TEMPERATURE K | 4 BAR ISOBAR MOLAR VOLUME $CM^3/G$ | INTERNAL ENERGY J/G | ENTHALPY J/G | ENTROPY J/G-K | SPECIFIC HEAT CV J/G-K | SPECIFIC HEAT CP J/G-K | VELOCITY OF SOUND M/S | $\left(\frac{\partial P}{\partial T}\right)_V$ BAR/K | $\left(\frac{\partial P}{\partial \rho}\right)_T$ BAR-$CM^3/G$ |
|---|---|---|---|---|---|---|---|---|---|
| * 13.935 | 12.95 | -308.8 | -303.6 | 4.98 | 4.69 | 6.39 | 1271 | 9.28 | 11878 |
| 14 | 12.96 | -308.4 | -303.2 | 5.01 | 4.71 | 6.41 | 1273 | 9.28 | 11903 |
| 15 | 13.10 | -301.8 | -296.5 | 5.47 | 4.91 | 6.95 | 1231 | 9.21 | 10719 |
| 16 | 13.25 | -294.7 | -289.4 | 5.93 | 5.10 | 7.38 | 1205 | 9.02 | 10043 |
| 17 | 13.41 | -287.1 | -281.8 | 6.39 | 5.29 | 7.85 | 1181 | 8.87 | 9402 |
| 18 | 13.59 | -279.1 | -273.7 | 6.85 | 5.45 | 8.32 | 1160 | 8.73 | 8827 |
| 19 | 13.78 | -270.6 | -265.1 | 7.31 | 5.60 | 8.84 | 1137 | 8.58 | 8191 |
| 20 | 13.99 | -261.6 | -256.0 | 7.78 | 5.73 | 9.40 | 1111 | 8.40 | 7524 |
| 21 | 14.22 | -252.0 | -246.3 | 8.26 | 5.85 | 10.01 | 1085 | 8.21 | 6868 |
| 22 | 14.47 | -241.8 | -236.0 | 8.74 | 5.94 | 10.69 | 1057 | 8.00 | 6216 |
| 23 | 14.76 | -230.8 | -224.9 | 9.23 | 6.02 | 11.46 | 1026 | 7.75 | 5532 |
| 24 | 15.09 | -219.0 | -213.0 | 9.74 | 6.09 | 12.37 | 991 | 7.45 | 4832 |
| 25 | 15.46 | -206.3 | -200.1 | 10.26 | 6.14 | 13.46 | 950 | 7.10 | 4122 |
| * 25.957 | 15.90 | -192.9 | -186.6 | 10.79 | 6.19 | 14.75 | 905 | 6.69 | 3437 |
| * 25.957 | 204.98 | 121.2 | 203.2 | 25.82 | 6.89 | 16.79 | 376 | 0.23 | 579 |
| 26 | 205.74 | 121.6 | 203.9 | 25.84 | 6.88 | 16.71 | 376 | 0.23 | 583 |
| 27 | 221.63 | 131.2 | 219.9 | 26.45 | 6.72 | 15.34 | 390 | 0.21 | 668 |
| 28 | 236.50 | 140.1 | 234.7 | 26.99 | 6.62 | 14.44 | 403 | 0.19 | 745 |
| 29 | 250.66 | 148.6 | 248.8 | 27.48 | 6.56 | 13.80 | 415 | 0.18 | 817 |
| 30 | 264.29 | 156.7 | 262.4 | 27.94 | 6.51 | 13.33 | 425 | 0.17 | 884 |
| 31 | 277.50 | 164.5 | 275.5 | 28.37 | 6.47 | 12.96 | 436 | 0.16 | 948 |
| 32 | 290.39 | 172.2 | 288.3 | 28.78 | 6.44 | 12.66 | 445 | 0.15 | 1009 |
| 33 | 303.01 | 179.7 | 300.9 | 29.17 | 6.42 | 12.42 | 455 | 0.15 | 1068 |
| 34 | 315.41 | 187.1 | 313.2 | 29.53 | 6.39 | 12.21 | 464 | 0.14 | 1126 |
| 35 | 327.62 | 194.3 | 325.3 | 29.89 | 6.37 | 12.03 | 473 | 0.13 | 1182 |
| 36 | 339.66 | 201.4 | 337.3 | 30.22 | 6.35 | 11.88 | 481 | 0.13 | 1237 |
| 37 | 351.57 | 208.5 | 349.1 | 30.55 | 6.34 | 11.76 | 489 | 0.12 | 1290 |
| 38 | 363.36 | 215.4 | 360.8 | 30.86 | 6.33 | 11.65 | 497 | 0.12 | 1343 |
| 39 | 375.04 | 222.4 | 372.4 | 31.16 | 6.32 | 11.55 | 505 | 0.12 | 1395 |
| 40 | 386.63 | 229.3 | 383.9 | 31.45 | 6.31 | 11.47 | 513 | 0.11 | 1446 |
| 42 | 409.56 | 242.9 | 406.7 | 32.01 | 6.30 | 11.33 | 527 | 0.11 | 1547 |
| 44 | 432.22 | 256.4 | 429.2 | 32.53 | 6.30 | 11.22 | 541 | 0.10 | 1645 |
| 46 | 454.65 | 269.7 | 451.6 | 33.03 | 6.30 | 11.14 | 555 | 0.09 | 1742 |
| 48 | 476.89 | 283.0 | 473.8 | 33.50 | 6.31 | 11.07 | 568 | 0.09 | 1837 |
| 50 | 498.97 | 296.3 | 495.9 | 33.95 | 6.33 | 11.03 | 580 | 0.09 | 1931 |
| 55 | 553.61 | 329.4 | 550.9 | 35.00 | 6.40 | 10.98 | 609 | 0.08 | 2162 |
| 60 | 607.64 | 362.8 | 605.8 | 35.96 | 6.53 | 11.02 | 635 | 0.07 | 2388 |
| 65 | 661.23 | 396.7 | 661.2 | 36.84 | 6.72 | 11.14 | 658 | 0.06 | 2610 |
| 70 | 714.49 | 431.6 | 717.4 | 37.68 | 6.96 | 11.34 | 679 | 0.06 | 2830 |
| 75 | 767.49 | 467.7 | 774.7 | 38.47 | 7.26 | 11.60 | 698 | 0.05 | 3047 |
| 80 | 820.29 | 505.4 | 833.5 | 39.22 | 7.61 | 11.92 | 715 | 0.05 | 3263 |
| 85 | 872.93 | 544.9 | 894.1 | 39.96 | 8.00 | 12.29 | 731 | 0.05 | 3478 |
| 90 | 925.43 | 586.3 | 956.5 | 40.67 | 8.42 | 12.69 | 746 | 0.05 | 3692 |
| 95 | 977.83 | 629.8 | 1021.0 | 41.37 | 8.85 | 13.10 | 760 | 0.04 | 3905 |
| 100 | 1030.13 | 675.5 | 1087.5 | 42.05 | 9.28 | 13.52 | 774 | 0.04 | 4117 |
| 110 | 1134.51 | 773.0 | 1226.8 | 43.38 | 10.11 | 14.33 | 802 | 0.04 | 4539 |
| 120 | 1238.65 | 878.3 | 1373.7 | 44.65 | 10.84 | 15.04 | 830 | 0.03 | 4960 |
| 130 | 1342.62 | 990.0 | 1527.0 | 45.88 | 11.41 | 15.60 | 857 | 0.03 | 5379 |
| 140 | 1446.46 | 1106.6 | 1685.1 | 47.05 | 11.83 | 16.00 | 886 | 0.03 | 5797 |
| 150 | 1550.19 | 1226.5 | 1846.6 | 48.17 | 12.09 | 16.26 | 914 | 0.03 | 6214 |
| 160 | 1653.83 | 1348.3 | 2009.9 | 49.22 | 12.22 | 16.38 | 943 | 0.03 | 6631 |
| 170 | 1757.40 | 1470.9 | 2173.8 | 50.22 | 12.24 | 16.40 | 972 | 0.02 | 7047 |
| 180 | 1860.92 | 1593.3 | 2337.6 | 51.15 | 12.19 | 16.35 | 1000 | 0.02 | 7463 |
| 190 | 1964.39 | 1714.8 | 2500.6 | 52.03 | 12.09 | 16.24 | 1029 | 0.02 | 7878 |
| 200 | 2067.82 | 1835.2 | 2662.3 | 52.86 | 11.95 | 16.10 | 1057 | 0.02 | 8293 |
| 220 | 2274.59 | 2071.2 | 2981.1 | 54.38 | 11.64 | 15.78 | 1112 | 0.02 | 9122 |
| 240 | 2481.25 | 2301.0 | 3293.5 | 55.74 | 11.33 | 15.47 | 1165 | 0.02 | 9950 |
| 260 | 2687.83 | 2525.2 | 3600.3 | 56.97 | 11.04 | 15.21 | 1217 | 0.02 | 10778 |
| 280 | 2894.36 | 2744.7 | 3902.4 | 58.09 | 10.88 | 15.01 | 1266 | 0.01 | 11605 |
| 300 | 3100.84 | 2960.7 | 4201.0 | 59.12 | 10.72 | 14.86 | 1312 | 0.01 | 12432 |

* TWO PHASE BOUNDARY

TABLE VI. THERMODYNAMIC PROPERTIES OF PARAHYDROGEN

5 BAR ISOBAR

| | TEMPERATURE K | MOLAR VOLUME $CM^3/G$ | INTERNAL ENERGY J/G | ENTHALPY J/G | ENTROPY J/G-K | SPECIFIC HEAT CV J/G-K | SPECIFIC HEAT CP J/G-K | VELOCITY OF SOUND M/S | $\left(\frac{\partial P}{\partial T}\right)_V$ BAR/K | $\left(\frac{\partial P}{\partial \rho}\right)_T$ BAR-$CM^3$/G |
|---|---|---|---|---|---|---|---|---|---|---|
| * | 13.968 | 12.94 | -308.8 | -302.3 | 4.98 | 4.70 | 6.39 | 1274 | 9.29 | 11942 |
| | 14 | 12.94 | -308.6 | -302.1 | 4.99 | 4.71 | 6.38 | 1279 | 9.29 | 12054 |
| | 15 | 13.08 | -302.0 | -295.4 | 5.45 | 4.91 | 6.93 | 1237 | 9.25 | 10821 |
| | 16 | 13.23 | -294.9 | -288.3 | 5.91 | 5.10 | 7.37 | 1210 | 9.06 | 10139 |
| | 17 | 13.39 | -287.4 | -280.7 | 6.37 | 5.28 | 7.81 | 1189 | 8.91 | 9560 |
| | 18 | 13.57 | -279.5 | -272.7 | 6.83 | 5.45 | 8.29 | 1166 | 8.76 | 8928 |
| | 19 | 13.75 | -271.0 | -264.1 | 7.29 | 5.60 | 8.81 | 1142 | 8.61 | 8296 |
| | 20 | 13.96 | -262.0 | -255.0 | 7.76 | 5.73 | 9.35 | 1118 | 8.44 | 7653 |
| | 21 | 14.19 | -252.5 | -245.4 | 8.23 | 5.84 | 9.97 | 1090 | 8.25 | 6969 |
| | 22 | 14.44 | -242.3 | -235.1 | 8.71 | 5.94 | 10.62 | 1063 | 8.03 | 6324 |
| | 23 | 14.72 | -231.5 | -224.1 | 9.20 | 6.02 | 11.37 | 1033 | 7.79 | 5648 |
| | 24 | 15.04 | -219.8 | -212.3 | 9.70 | 6.09 | 12.25 | 998 | 7.50 | 4952 |
| | 25 | 15.41 | -207.3 | -199.6 | 10.22 | 6.14 | 13.29 | 959 | 7.16 | 4251 |
| | 26 | 15.85 | -193.6 | -185.6 | 10.77 | 6.19 | 14.61 | 912 | 6.75 | 3528 |
| | 27 | 16.38 | -178.4 | -170.2 | 11.35 | 6.25 | 16.43 | 856 | 6.26 | 2793 |
| * | 27.115 | 16.45 | -176.5 | -168.2 | 11.42 | 6.26 | 16.62 | 850 | 6.20 | 2725 |
| * | 27.116 | 162.92 | 119.0 | 200.5 | 25.03 | 7.01 | 19.92 | 378 | 0.30 | 528 |
| | 28 | 175.44 | 128.6 | 216.3 | 25.60 | 6.84 | 17.03 | 391 | 0.27 | 615 |
| | 29 | 188.41 | 138.4 | 232.6 | 26.17 | 6.72 | 15.69 | 405 | 0.25 | 701 |
| | 30 | 200.56 | 147.6 | 247.8 | 26.69 | 6.64 | 14.78 | 417 | 0.23 | 780 |
| | 31 | 212.13 | 156.2 | 262.3 | 27.16 | 6.58 | 14.13 | 428 | 0.21 | 854 |
| | 32 | 223.25 | 164.5 | 276.1 | 27.60 | 6.53 | 13.63 | 439 | 0.20 | 923 |
| | 33 | 234.04 | 172.6 | 289.6 | 28.02 | 6.50 | 13.23 | 449 | 0.19 | 988 |
| | 34 | 244.55 | 180.4 | 302.6 | 28.41 | 6.45 | 12.90 | 458 | 0.18 | 1051 |
| | 35 | 254.83 | 188.0 | 315.4 | 28.78 | 6.42 | 12.64 | 468 | 0.17 | 1112 |
| | 36 | 264.92 | 195.5 | 327.9 | 29.13 | 6.40 | 12.42 | 477 | 0.17 | 1171 |
| | 37 | 274.85 | 202.8 | 340.3 | 29.47 | 6.38 | 12.23 | 485 | 0.16 | 1229 |
| | 38 | 284.65 | 210.1 | 352.4 | 29.79 | 6.36 | 12.07 | 494 | 0.15 | 1285 |
| | 39 | 294.33 | 217.2 | 364.4 | 30.10 | 6.35 | 11.94 | 502 | 0.15 | 1340 |
| | 40 | 303.90 | 224.3 | 376.3 | 30.40 | 6.34 | 11.82 | 510 | 0.14 | 1394 |
| | 42 | 322.78 | 238.3 | 399.7 | 30.98 | 6.33 | 11.63 | 525 | 0.13 | 1500 |
| | 44 | 341.37 | 252.1 | 422.8 | 31.51 | 6.32 | 11.48 | 539 | 0.13 | 1603 |
| | 46 | 359.71 | 265.8 | 445.7 | 32.02 | 6.32 | 11.36 | 553 | 0.12 | 1703 |
| | 48 | 377.86 | 279.4 | 468.3 | 32.50 | 6.33 | 11.27 | 566 | 0.11 | 1802 |
| | 50 | 395.84 | 292.8 | 490.8 | 32.96 | 6.35 | 11.20 | 579 | 0.11 | 1899 |
| | 55 | 440.20 | 326.4 | 546.5 | 34.02 | 6.42 | 11.11 | 608 | 0.10 | 2136 |
| | 60 | 483.93 | 360.1 | 602.1 | 34.99 | 6.54 | 11.13 | 634 | 0.09 | 2367 |
| | 65 | 527.22 | 394.3 | 657.9 | 35.89 | 6.72 | 11.23 | 658 | 0.08 | 2593 |
| | 70 | 570.17 | 429.4 | 714.5 | 36.72 | 6.97 | 11.41 | 679 | 0.07 | 2816 |
| | 75 | 612.85 | 465.7 | 772.1 | 37.52 | 7.27 | 11.66 | 698 | 0.07 | 3036 |
| | 80 | 655.34 | 503.6 | 831.2 | 38.28 | 7.62 | 11.98 | 715 | 0.06 | 3255 |
| | 85 | 697.66 | 543.2 | 892.0 | 39.02 | 8.01 | 12.33 | 731 | 0.06 | 3472 |
| | 90 | 739.85 | 584.7 | 954.6 | 39.73 | 8.42 | 12.73 | 746 | 0.06 | 3687 |
| | 95 | 781.93 | 628.3 | 1019.3 | 40.43 | 8.85 | 13.14 | 761 | 0.05 | 3902 |
| | 100 | 823.92 | 674.0 | 1086.0 | 41.12 | 9.28 | 13.55 | 775 | 0.05 | 4115 |
| | 110 | 907.67 | 771.7 | 1225.6 | 42.44 | 10.12 | 14.35 | 803 | 0.05 | 4540 |
| | 120 | 991.18 | 877.1 | 1372.7 | 43.73 | 10.84 | 15.06 | 830 | 0.04 | 4963 |
| | 130 | 1074.52 | 988.9 | 1526.2 | 44.95 | 11.41 | 15.61 | 858 | 0.04 | 5383 |
| | 140 | 1157.73 | 1105.6 | 1684.5 | 46.13 | 11.83 | 16.02 | 886 | 0.04 | 5803 |
| | 150 | 1240.83 | 1225.6 | 1846.1 | 47.24 | 12.09 | 16.27 | 915 | 0.03 | 6221 |
| | 160 | 1323.85 | 1347.5 | 2009.5 | 48.30 | 12.22 | 16.39 | 944 | 0.03 | 6639 |
| | 170 | 1406.80 | 1470.2 | 2173.6 | 49.29 | 12.24 | 16.41 | 972 | 0.03 | 7056 |
| | 180 | 1489.69 | 1592.6 | 2337.5 | 50.23 | 12.19 | 16.35 | 1001 | 0.03 | 7472 |
| | 190 | 1572.53 | 1714.2 | 2500.5 | 51.11 | 12.09 | 16.25 | 1030 | 0.03 | 7888 |
| | 200 | 1655.34 | 1834.6 | 2662.3 | 51.94 | 11.95 | 16.10 | 1058 | 0.03 | 8304 |
| | 220 | 1820.85 | 2070.7 | 2981.2 | 53.46 | 11.64 | 15.78 | 1113 | 0.02 | 9134 |
| | 240 | 1986.26 | 2300.6 | 3293.7 | 54.82 | 11.33 | 15.48 | 1166 | 0.02 | 9963 |
| | 260 | 2151.60 | 2524.8 | 3600.6 | 56.05 | 11.09 | 15.22 | 1217 | 0.02 | 10791 |
| | 280 | 2316.88 | 2744.3 | 3902.8 | 57.17 | 10.88 | 15.01 | 1266 | 0.02 | 11619 |
| | 300 | 2482.11 | 2960.4 | 4201.4 | 58.20 | 10.72 | 14.86 | 1313 | 0.02 | 12446 |

* TWO PHASE BOUNDARY

TABLE VI. THERMODYNAMIC PROPERTIES OF PARAHYDROGEN

| | 6 BAR ISOBAR TEMPERATURE K | MOLAR VOLUME $CM^3/G$ | INTERNAL ENERGY J/G | ENTHALPY J/G | ENTROPY J/G-K | SPECIFIC HEAT CV J/G-K | SPECIFIC HEAT CP J/G-K | VELOCITY OF SOUND M/S | $\left(\frac{\partial P}{\partial T}\right)_V$ BAR/K | $\left(\frac{\partial P}{\partial \rho}\right)_T$ BAR-$CM^3$/G |
|---|---|---|---|---|---|---|---|---|---|---|
| * | 14.001 | 12.93 | -308.7 | -301.9 | 4.98 | 4.73 | 6.38 | 1280 | 9.30 | 12079 |
| | 15 | 13.06 | -302.2 | -294.4 | 5.44 | 4.93 | 6.92 | 1242 | 9.28 | 10921 |
| | 16 | 13.21 | -295.2 | -287.3 | 5.89 | 5.10 | 7.33 | 1219 | 9.10 | 10322 |
| | 17 | 13.37 | -287.7 | -279.7 | 6.35 | 5.28 | 7.79 | 1194 | 8.94 | 9661 |
| | 18 | 13.55 | -279.8 | -271.6 | 6.81 | 5.44 | 8.27 | 1171 | 8.79 | 9028 |
| | 19 | 13.73 | -271.4 | -263.1 | 7.28 | 5.59 | 8.77 | 1148 | 8.64 | 8399 |
| | 20 | 13.93 | -262.4 | -254.1 | 7.74 | 5.72 | 9.31 | 1123 | 8.47 | 7756 |
| | 21 | 14.16 | -253.0 | -244.5 | 8.21 | 5.84 | 9.90 | 1098 | 8.28 | 7108 |
| | 22 | 14.41 | -242.9 | -234.2 | 8.68 | 5.93 | 10.56 | 1069 | 8.07 | 6429 |
| | 23 | 14.68 | -232.1 | -223.3 | 9.17 | 6.01 | 11.29 | 1040 | 7.83 | 5761 |
| | 24 | 14.99 | -220.6 | -211.6 | 9.67 | 6.08 | 12.12 | 1007 | 7.54 | 5082 |
| | 25 | 15.35 | -208.2 | -199.0 | 10.18 | 6.14 | 13.14 | 968 | 7.21 | 4376 |
| | 26 | 15.78 | -194.7 | -185.3 | 10.72 | 6.19 | 14.38 | 923 | 6.81 | 3665 |
| | 27 | 16.29 | -179.9 | -170.1 | 11.29 | 6.25 | 16.08 | 869 | 6.35 | 2934 |
| | 28 | 16.94 | -163.1 | -152.9 | 11.92 | 6.32 | 18.57 | 807 | 5.81 | 2216 |
| * | 28.123 | 17.04 | -160.8 | -150.6 | 12.00 | 6.34 | 18.60 | 802 | 5.73 | 2190 |
| * | 28.123 | 133.77 | 115.6 | 195.8 | 24.32 | 7.13 | 21.64 | 378 | 0.37 | 472 |
| | 29 | 145.31 | 126.3 | 213.5 | 24.94 | 6.95 | 18.80 | 393 | 0.33 | 570 |
| | 30 | 157.00 | 137.1 | 231.3 | 25.55 | 6.81 | 16.93 | 407 | 0.30 | 667 |
| | 31 | 167.78 | 146.9 | 247.6 | 26.08 | 6.72 | 15.73 | 420 | 0.28 | 752 |
| | 32 | 177.93 | 156.1 | 262.9 | 26.57 | 6.64 | 14.88 | 431 | 0.26 | 831 |
| | 33 | 187.63 | 164.9 | 277.5 | 27.02 | 6.59 | 14.25 | 442 | 0.24 | 905 |
| | 34 | 196.98 | 173.3 | 291.4 | 27.43 | 6.53 | 13.75 | 453 | 0.23 | 974 |
| | 35 | 206.04 | 181.4 | 305.0 | 27.83 | 6.48 | 13.35 | 463 | 0.22 | 1041 |
| | 36 | 214.88 | 189.2 | 318.2 | 28.20 | 6.45 | 13.03 | 472 | 0.21 | 1105 |
| | 37 | 223.54 | 196.9 | 331.1 | 28.55 | 6.42 | 12.77 | 482 | 0.20 | 1166 |
| | 38 | 232.04 | 204.5 | 343.7 | 28.89 | 6.40 | 12.55 | 490 | 0.19 | 1226 |
| | 39 | 240.41 | 211.9 | 356.2 | 29.21 | 6.38 | 12.37 | 499 | 0.18 | 1285 |
| | 40 | 248.66 | 219.3 | 368.5 | 29.52 | 6.37 | 12.21 | 507 | 0.18 | 1342 |
| | 42 | 264.87 | 233.7 | 392.6 | 30.11 | 6.35 | 11.95 | 523 | 0.17 | 1453 |
| | 44 | 280.77 | 247.8 | 416.3 | 30.66 | 6.34 | 11.75 | 538 | 0.16 | 1560 |
| | 46 | 296.40 | 261.8 | 439.6 | 31.18 | 6.34 | 11.59 | 552 | 0.15 | 1665 |
| | 48 | 311.83 | 275.6 | 462.7 | 31.67 | 6.35 | 11.47 | 565 | 0.14 | 1767 |
| | 50 | 327.08 | 289.3 | 485.6 | 32.14 | 6.36 | 11.38 | 578 | 0.13 | 1867 |
| | 55 | 364.60 | 323.3 | 542.1 | 33.22 | 6.43 | 11.25 | 608 | 0.12 | 2110 |
| | 60 | 401.47 | 357.4 | 598.3 | 34.19 | 6.55 | 11.23 | 634 | 0.11 | 2346 |
| | 65 | 437.89 | 391.9 | 654.6 | 35.10 | 6.73 | 11.32 | 658 | 0.10 | 2576 |
| | 70 | 473.97 | 427.2 | 711.6 | 35.94 | 6.97 | 11.48 | 679 | 0.09 | 2802 |
| | 75 | 509.78 | 463.7 | 769.6 | 36.74 | 7.27 | 11.72 | 698 | 0.08 | 3026 |
| | 80 | 545.39 | 501.7 | 828.9 | 37.51 | 7.62 | 12.03 | 716 | 0.08 | 3247 |
| | 85 | 580.83 | 541.4 | 889.9 | 38.25 | 8.01 | 12.38 | 732 | 0.07 | 3466 |
| | 90 | 616.15 | 583.1 | 952.8 | 38.96 | 8.42 | 12.77 | 747 | 0.07 | 3683 |
| | 95 | 651.35 | 626.8 | 1017.6 | 39.67 | 8.85 | 13.17 | 761 | 0.06 | 3899 |
| | 100 | 686.46 | 672.6 | 1084.5 | 40.35 | 9.29 | 13.58 | 776 | 0.06 | 4114 |
| | 110 | 756.45 | 770.5 | 1224.4 | 41.68 | 10.12 | 14.38 | 803 | 0.06 | 4541 |
| | 120 | 826.21 | 876.0 | 1371.7 | 42.96 | 10.84 | 15.08 | 831 | 0.05 | 4966 |
| | 130 | 895.80 | 987.9 | 1525.4 | 44.19 | 11.41 | 15.63 | 859 | 0.05 | 5388 |
| | 140 | 965.25 | 1104.7 | 1683.9 | 45.37 | 11.83 | 16.03 | 887 | 0.04 | 5809 |
| | 150 | 1034.60 | 1224.8 | 1845.6 | 46.48 | 12.09 | 16.28 | 916 | 0.04 | 6229 |
| | 160 | 1103.87 | 1346.8 | 2009.1 | 47.54 | 12.22 | 16.40 | 945 | 0.04 | 6647 |
| | 170 | 1173.07 | 1469.4 | 2173.3 | 48.53 | 12.25 | 16.42 | 973 | 0.04 | 7065 |
| | 180 | 1242.21 | 1591.9 | 2337.3 | 49.47 | 12.19 | 16.36 | 1002 | 0.03 | 7482 |
| | 190 | 1311.30 | 1713.6 | 2500.4 | 50.35 | 12.09 | 16.25 | 1030 | 0.03 | 7899 |
| | 200 | 1380.35 | 1834.0 | 2662.2 | 51.18 | 11.95 | 16.11 | 1059 | 0.03 | 8315 |
| | 220 | 1518.36 | 2070.2 | 2981.2 | 52.70 | 11.64 | 15.79 | 1114 | 0.03 | 9146 |
| | 240 | 1656.27 | 2300.1 | 3293.9 | 54.06 | 11.33 | 15.48 | 1167 | 0.03 | 9976 |
| | 260 | 1794.11 | 2524.4 | 3600.8 | 55.29 | 11.08 | 15.22 | 1218 | 0.02 | 10805 |
| | 280 | 1931.89 | 2744.0 | 3903.1 | 56.41 | 10.88 | 15.02 | 1267 | 0.02 | 11633 |
| | 300 | 2069.62 | 2960.0 | 4201.8 | 57.44 | 10.72 | 14.86 | 1314 | 0.02 | 12461 |

* TWO PHASE BOUNDARY

TABLE VI. THERMODYNAMIC PROPERTIES OF PARAHYDROGEN

7 BAR ISOBAR

| | TEMPERATURE K | MOLAR VOLUME CM3/G | INTERNAL ENERGY J/G | ENTHALPY J/G | ENTROPY J/G-K | SPECIFIC HEAT CV J/G-K | SPECIFIC HEAT CP J/G-K | VELOCITY OF SOUND M/S | $\left(\frac{\partial P}{\partial T}\right)_V$ BAR/K | $\left(\frac{\partial P}{\partial \rho}\right)_T$ BAR-CM3/G |
|---|---|---|---|---|---|---|---|---|---|---|
| * | 14.034 | 12.92 | -308.7 | -299.7 | 4.98 | 4.71 | 6.38 | 1283 | 9.31 | 12146 |
| | 15 | 13.05 | -302.4 | -293.3 | 5.42 | 4.90 | 6.88 | 1254 | 9.31 | 11213 |
| | 16 | 13.19 | -295.4 | -286.2 | 5.88 | 5.09 | 7.32 | 1224 | 9.13 | 10427 |
| | 17 | 13.35 | -288.0 | -278.6 | 6.34 | 5.27 | 7.77 | 1199 | 8.97 | 9762 |
| | 18 | 13.53 | -280.1 | -270.6 | 6.80 | 5.44 | 8.25 | 1176 | 8.82 | 9176 |
| | 19 | 13.71 | -271.7 | -262.1 | 7.26 | 5.59 | 8.74 | 1153 | 8.67 | 8501 |
| | 20 | 13.91 | -262.8 | -253.1 | 7.72 | 5.72 | 9.28 | 1129 | 8.50 | 7858 |
| | 21 | 14.13 | -253.4 | -243.5 | 8.18 | 5.83 | 9.85 | 1104 | 8.31 | 7214 |
| | 22 | 14.37 | -243.4 | -233.4 | 8.66 | 5.93 | 10.48 | 1076 | 8.10 | 6555 |
| | 23 | 14.64 | -232.8 | -222.5 | 9.14 | 6.01 | 11.21 | 1046 | 7.87 | 5872 |
| | 24 | 14.95 | -221.4 | -210.9 | 9.63 | 6.08 | 12.02 | 1014 | 7.59 | 5201 |
| | 25 | 15.30 | -209.1 | -198.4 | 10.14 | 6.13 | 13.00 | 976 | 7.26 | 4498 |
| | 26 | 15.71 | -195.9 | -184.9 | 10.67 | 6.18 | 14.14 | 934 | 6.88 | 3816 |
| | 27 | 16.20 | -181.4 | -170.0 | 11.24 | 6.24 | 15.68 | 883 | 6.43 | 3102 |
| | 28 | 16.82 | -165.0 | -153.3 | 11.85 | 6.31 | 18.03 | 822 | 5.91 | 2364 |
| | 29 | 17.65 | -146.0 | -133.6 | 12.53 | 6.41 | 21.71 | 750 | 5.30 | 1660 |
| * | 29.019 | 17.67 | -145.6 | -133.2 | 12.55 | 6.41 | 21.70 | 749 | 5.29 | 1659 |
| * | 29.019 | 112.13 | 110.8 | 189.3 | 23.67 | 7.28 | 25.29 | 378 | 0.45 | 412 |
| | 30 | 124.49 | 124.6 | 211.7 | 24.43 | 7.04 | 20.53 | 396 | 0.39 | 537 |
| | 31 | 135.21 | 136.3 | 230.9 | 25.06 | 6.89 | 18.10 | 411 | 0.36 | 641 |
| | 32 | 144.94 | 146.8 | 248.2 | 25.61 | 6.79 | 16.60 | 424 | 0.33 | 733 |
| | 33 | 154.04 | 156.5 | 264.3 | 26.10 | 6.70 | 15.56 | 435 | 0.30 | 817 |
| | 34 | 162.66 | 165.6 | 279.5 | 26.55 | 6.62 | 14.79 | 447 | 0.28 | 894 |
| | 35 | 170.94 | 174.3 | 294.0 | 26.97 | 6.55 | 14.21 | 458 | 0.27 | 967 |
| | 36 | 178.95 | 182.7 | 307.9 | 27.37 | 6.50 | 13.75 | 468 | 0.26 | 1036 |
| | 37 | 186.74 | 190.8 | 321.5 | 27.74 | 6.47 | 13.39 | 478 | 0.24 | 1102 |
| | 38 | 194.34 | 198.7 | 334.7 | 28.09 | 6.44 | 13.09 | 487 | 0.23 | 1167 |
| | 39 | 201.80 | 206.4 | 347.7 | 28.43 | 6.42 | 12.84 | 496 | 0.22 | 1229 |
| | 40 | 209.13 | 214.0 | 360.4 | 28.75 | 6.40 | 12.63 | 504 | 0.21 | 1289 |
| | 42 | 223.46 | 228.9 | 385.3 | 29.36 | 6.38 | 12.29 | 521 | 0.20 | 1406 |
| | 44 | 237.45 | 243.4 | 409.7 | 29.93 | 6.36 | 12.04 | 536 | 0.19 | 1518 |
| | 46 | 251.16 | 257.7 | 433.5 | 30.46 | 6.36 | 11.84 | 550 | 0.18 | 1627 |
| | 48 | 264.66 | 271.8 | 457.1 | 30.96 | 6.36 | 11.69 | 564 | 0.17 | 1732 |
| | 50 | 277.96 | 285.7 | 480.3 | 31.43 | 6.38 | 11.57 | 577 | 0.16 | 1835 |
| | 55 | 310.61 | 320.2 | 537.7 | 32.52 | 6.44 | 11.39 | 607 | 0.14 | 2085 |
| | 60 | 342.59 | 354.7 | 594.5 | 33.51 | 6.55 | 11.34 | 634 | 0.13 | 2326 |
| | 65 | 374.10 | 389.4 | 651.3 | 34.42 | 6.74 | 11.40 | 658 | 0.11 | 2560 |
| | 70 | 405.27 | 425.0 | 708.7 | 35.27 | 6.98 | 11.56 | 680 | 0.11 | 2789 |
| | 75 | 436.17 | 461.7 | 767.0 | 36.08 | 7.28 | 11.79 | 699 | 0.10 | 3016 |
| | 80 | 466.86 | 499.8 | 826.6 | 36.85 | 7.63 | 12.08 | 716 | 0.09 | 3239 |
| | 85 | 497.40 | 539.7 | 887.9 | 37.59 | 8.01 | 12.42 | 732 | 0.09 | 3460 |
| | 90 | 527.80 | 581.5 | 950.9 | 38.31 | 8.43 | 12.80 | 748 | 0.08 | 3679 |
| | 95 | 558.09 | 625.3 | 1016.0 | 39.01 | 8.86 | 13.20 | 762 | 0.08 | 3896 |
| | 100 | 588.28 | 671.2 | 1083.0 | 39.70 | 9.29 | 13.61 | 776 | 0.07 | 4113 |
| | 110 | 648.45 | 769.2 | 1223.2 | 41.03 | 10.12 | 14.40 | 804 | 0.06 | 4542 |
| | 120 | 708.38 | 874.9 | 1370.8 | 42.32 | 10.84 | 15.10 | 832 | 0.06 | 4969 |
| | 130 | 768.15 | 996.9 | 1524.6 | 43.55 | 11.42 | 15.65 | 860 | 0.05 | 5393 |
| | 140 | 827.78 | 1103.8 | 1683.2 | 44.73 | 11.83 | 16.05 | 888 | 0.05 | 5815 |
| | 150 | 887.30 | 1223.9 | 1845.1 | 45.84 | 12.09 | 16.29 | 917 | 0.05 | 6236 |
| | 160 | 946.74 | 1346.0 | 2008.7 | 46.90 | 12.22 | 16.41 | 945 | 0.04 | 6655 |
| | 170 | 1006.12 | 1468.7 | 2173.0 | 47.89 | 12.25 | 16.43 | 974 | 0.04 | 7074 |
| | 180 | 1065.43 | 1591.3 | 2337.1 | 48.83 | 12.19 | 16.37 | 1003 | 0.04 | 7492 |
| | 190 | 1124.71 | 1713.8 | 2500.3 | 49.71 | 12.09 | 16.26 | 1031 | 0.04 | 7909 |
| | 200 | 1183.94 | 1833.4 | 2662.2 | 50.54 | 11.95 | 16.12 | 1059 | 0.04 | 8326 |
| | 220 | 1302.30 | 2069.7 | 2981.3 | 52.07 | 11.64 | 15.80 | 1115 | 0.03 | 9158 |
| | 240 | 1420.57 | 2299.7 | 3294.1 | 53.43 | 11.33 | 15.49 | 1168 | 0.03 | 9989 |
| | 260 | 1538.76 | 2524.0 | 3601.1 | 54.66 | 11.08 | 15.23 | 1219 | 0.03 | 10818 |
| | 280 | 1656.89 | 2743.6 | 3903.4 | 55.78 | 10.88 | 15.02 | 1268 | 0.03 | 11647 |
| | 300 | 1774.98 | 2959.7 | 4202.2 | 56.81 | 10.73 | 14.86 | 1315 | 0.02 | 12475 |

* TWO PHASE BOUNDARY

TABLE VI. THERMODYNAMIC PROPERTIES OF PARAHYDROGEN

| | 8 BAR ISOBAR TEMPERATURE K | MOLAR VOLUME CM3/G | INTERNAL ENERGY J/G | ENTHALPY J/G | ENTROPY J/G-K | SPECIFIC HEAT CV J/G-K | SPECIFIC HEAT CP J/G-K | VELOCITY OF SOUND M/S | $\left(\frac{\partial P}{\partial T}\right)_V$ BAR/K | $\left(\frac{\partial P}{\partial \rho}\right)_T$ BAR-CM3/G |
|---|---|---|---|---|---|---|---|---|---|---|
| * | 14.067 | 12.91 | -308.7 | -298.3 | 4.99 | 4.71 | 6.38 | 1286 | 9.32 | 12213 |
| | 15 | 13.04 | -302.6 | -292.2 | 5.41 | 4.90 | 6.85 | 1259 | 9.32 | 11343 |
| | 16 | 13.18 | -295.6 | -285.1 | 5.87 | 5.09 | 7.30 | 1229 | 9.16 | 10531 |
| | 17 | 13.34 | -288.2 | -277.6 | 6.32 | 5.27 | 7.75 | 1204 | 9.00 | 9861 |
| | 18 | 13.51 | -280.4 | -269.6 | 6.78 | 5.43 | 8.22 | 1181 | 8.85 | 9224 |
| | 19 | 13.69 | -272.0 | -261.1 | 7.24 | 5.58 | 8.71 | 1159 | 8.70 | 8601 |
| | 20 | 13.89 | -263.2 | -252.1 | 7.70 | 5.71 | 9.24 | 1134 | 8.53 | 7958 |
| | 21 | 14.10 | -253.9 | -242.6 | 8.16 | 5.83 | 9.80 | 1109 | 8.35 | 7319 |
| | 22 | 14.34 | -244.0 | -232.5 | 8.63 | 5.93 | 10.42 | 1082 | 8.14 | 6662 |
| | 23 | 14.61 | -233.4 | -221.7 | 9.11 | 6.01 | 11.14 | 1053 | 7.90 | 5980 |
| | 24 | 14.91 | -222.1 | -210.2 | 9.60 | 6.08 | 11.92 | 1021 | 7.63 | 5316 |
| | 25 | 15.25 | -210.0 | -197.8 | 10.11 | 6.13 | 12.83 | 985 | 7.31 | 4638 |
| | 26 | 15.65 | -197.0 | -184.5 | 10.63 | 6.18 | 13.94 | 944 | 6.94 | 3951 |
| | 27 | 16.12 | -182.7 | -169.8 | 11.18 | 6.24 | 15.39 | 895 | 6.51 | 3243 |
| | 28 | 16.70 | -166.9 | -153.5 | 11.78 | 6.30 | 17.39 | 838 | 6.01 | 2545 |
| | 29 | 17.47 | -148.6 | -134.6 | 12.44 | 6.39 | 20.66 | 769 | 5.43 | 1831 |
| * | 29.828 | 18.37 | -130.4 | -115.7 | 13.08 | 6.49 | 25.51 | 700 | 4.86 | 1248 |
| * | 29.828 | 95.20 | 104.8 | 181.0 | 23.03 | 7.46 | 30.50 | 378 | 0.55 | 349 |
| | 30 | 97.84 | 108.2 | 186.5 | 23.22 | 7.39 | 28.36 | 382 | 0.53 | 379 |
| | 31 | 109.58 | 123.5 | 211.2 | 24.03 | 7.12 | 22.06 | 400 | 0.46 | 516 |
| | 32 | 119.46 | 136.1 | 231.6 | 24.68 | 6.95 | 19.10 | 415 | 0.41 | 627 |
| | 33 | 128.35 | 147.2 | 249.9 | 25.24 | 6.84 | 17.33 | 428 | 0.37 | 723 |
| | 34 | 136.58 | 157.3 | 266.5 | 25.74 | 6.71 | 16.12 | 441 | 0.35 | 810 |
| | 35 | 144.36 | 166.7 | 282.2 | 26.19 | 6.63 | 15.25 | 453 | 0.32 | 890 |
| | 36 | 151.80 | 175.7 | 297.1 | 26.61 | 6.56 | 14.61 | 464 | 0.31 | 966 |
| | 37 | 158.98 | 184.3 | 311.5 | 27.00 | 6.52 | 14.10 | 474 | 0.29 | 1037 |
| | 38 | 165.95 | 192.6 | 325.4 | 27.37 | 6.48 | 13.70 | 484 | 0.28 | 1106 |
| | 39 | 172.75 | 200.7 | 338.9 | 27.73 | 6.45 | 13.37 | 493 | 0.26 | 1172 |
| | 40 | 179.41 | 208.6 | 352.1 | 28.06 | 6.43 | 13.10 | 502 | 0.25 | 1236 |
| | 42 | 192.36 | 224.0 | 377.9 | 28.69 | 6.40 | 12.67 | 518 | 0.23 | 1359 |
| | 44 | 204.94 | 238.9 | 402.9 | 29.27 | 6.39 | 12.35 | 534 | 0.22 | 1476 |
| | 46 | 217.22 | 253.6 | 427.3 | 29.81 | 6.38 | 12.10 | 549 | 0.20 | 1588 |
| | 48 | 229.27 | 267.9 | 451.3 | 30.32 | 6.38 | 11.91 | 563 | 0.19 | 1698 |
| | 50 | 241.13 | 282.1 | 475.0 | 30.81 | 6.39 | 11.77 | 576 | 0.18 | 1804 |
| | 55 | 270.12 | 317.1 | 533.2 | 31.92 | 6.45 | 11.54 | 607 | 0.16 | 2060 |
| | 60 | 298.43 | 351.9 | 590.7 | 32.92 | 6.57 | 11.46 | 634 | 0.15 | 2306 |
| | 65 | 326.27 | 387.0 | 648.0 | 33.84 | 6.75 | 11.49 | 658 | 0.13 | 2544 |
| | 70 | 353.75 | 422.8 | 705.8 | 34.69 | 6.99 | 11.63 | 680 | 0.12 | 2777 |
| | 75 | 380.97 | 459.6 | 764.4 | 35.50 | 7.28 | 11.85 | 699 | 0.11 | 3006 |
| | 80 | 407.98 | 498.0 | 824.4 | 36.27 | 7.63 | 12.13 | 717 | 0.10 | 3231 |
| | 85 | 434.83 | 538.0 | 885.8 | 37.02 | 8.02 | 12.47 | 733 | 0.10 | 3454 |
| | 90 | 461.54 | 579.9 | 949.1 | 37.74 | 8.43 | 12.84 | 748 | 0.09 | 3675 |
| | 95 | 488.15 | 623.8 | 1014.3 | 38.45 | 8.86 | 13.24 | 763 | 0.09 | 3894 |
| | 100 | 514.66 | 669.8 | 1081.5 | 39.14 | 9.29 | 13.64 | 777 | 0.08 | 4112 |
| | 110 | 567.45 | 768.0 | 1222.0 | 40.47 | 10.12 | 14.43 | 805 | 0.07 | 4544 |
| | 120 | 620.02 | 873.8 | 1369.8 | 41.76 | 10.84 | 15.12 | 832 | 0.07 | 4972 |
| | 130 | 672.41 | 985.9 | 1523.8 | 42.99 | 11.42 | 15.67 | 861 | 0.06 | 5398 |
| | 140 | 724.67 | 1102.9 | 1682.6 | 44.17 | 11.83 | 16.06 | 889 | 0.06 | 5821 |
| | 150 | 776.83 | 1223.1 | 1844.6 | 45.29 | 12.09 | 16.31 | 917 | 0.05 | 6243 |
| | 160 | 828.90 | 1345.2 | 2008.3 | 46.34 | 12.22 | 16.42 | 946 | 0.05 | 6664 |
| | 170 | 880.91 | 1468.0 | 2172.7 | 47.34 | 12.25 | 16.44 | 975 | 0.05 | 7083 |
| | 180 | 932.86 | 1590.6 | 2336.9 | 48.28 | 12.20 | 16.38 | 1004 | 0.04 | 7502 |
| | 190 | 984.76 | 1712.4 | 2500.2 | 49.16 | 12.09 | 16.27 | 1032 | 0.04 | 7920 |
| | 200 | 1036.63 | 1832.9 | 2662.2 | 49.99 | 11.95 | 16.12 | 1060 | 0.04 | 8337 |
| | 220 | 1140.26 | 2069.2 | 2981.4 | 51.51 | 11.64 | 15.80 | 1116 | 0.04 | 9170 |
| | 240 | 1243.79 | 2299.2 | 3294.3 | 52.87 | 11.34 | 15.49 | 1169 | 0.03 | 10001 |
| | 260 | 1347.25 | 2523.6 | 3601.4 | 54.10 | 11.08 | 15.23 | 1220 | 0.03 | 10832 |
| | 280 | 1450.65 | 2743.3 | 3903.8 | 55.22 | 10.88 | 15.02 | 1269 | 0.03 | 11661 |
| | 300 | 1554.01 | 2959.4 | 4202.6 | 56.25 | 10.73 | 14.87 | 1316 | 0.03 | 12490 |

* TWO PHASE BOUNDARY

TABLE VI. THERMODYNAMIC PROPERTIES OF PARAHYDROGEN

| | TEMPERATURE K | MOLAR VOLUME $CM^3/G$ | INTERNAL ENERGY J/G | ENTHALPY J/G | ENTROPY J/G-K | SPECIFIC HEAT CV J/G-K | SPECIFIC HEAT CP J/G-K | VELOCITY OF SOUND M/S | $\left(\frac{\partial P}{\partial T}\right)_V$ BAR/K | $\left(\frac{\partial P}{\partial \rho}\right)_T$ BAR-$CM^3$/G |
|---|---|---|---|---|---|---|---|---|---|---|
| | 9 BAR ISOBAR | | | | | | | | | |
| * | 14.103 | 12.90 | -308.6 | -297.3 | 4.99 | 4.72 | 6.33 | 1289 | 9.34 | 12279 |
| | 15 | 13.02 | -302.8 | -291.1 | 5.40 | 4.90 | 6.83 | 1265 | 9.33 | 11473 |
| | 16 | 13.16 | -295.9 | -284.0 | 5.85 | 5.09 | 7.29 | 1234 | 9.18 | 10634 |
| | 17 | 13.32 | -288.5 | -276.5 | 6.31 | 5.27 | 7.73 | 1209 | 9.03 | 9960 |
| | 18 | 13.49 | -280.7 | -268.5 | 6.76 | 5.43 | 8.20 | 1186 | 8.88 | 9320 |
| | 19 | 13.67 | -272.4 | -260.1 | 7.22 | 5.58 | 8.69 | 1164 | 8.73 | 8701 |
| | 20 | 13.86 | -263.6 | -251.1 | 7.68 | 5.71 | 9.21 | 1140 | 8.56 | 8058 |
| | 21 | 14.08 | -254.3 | -241.7 | 8.14 | 5.82 | 9.76 | 1115 | 8.38 | 7422 |
| | 22 | 14.31 | -244.5 | -231.6 | 8.61 | 5.92 | 10.37 | 1088 | 8.17 | 6768 |
| | 23 | 14.57 | -234.0 | -220.9 | 9.08 | 6.01 | 11.05 | 1060 | 7.94 | 6110 |
| | 24 | 14.87 | -222.8 | -209.5 | 9.57 | 6.07 | 11.82 | 1028 | 7.67 | 5429 |
| | 25 | 15.20 | -210.9 | -197.2 | 10.07 | 6.13 | 12.70 | 993 | 7.36 | 4762 |
| | 26 | 15.59 | -198.0 | -184.0 | 10.59 | 6.18 | 13.76 | 953 | 7.00 | 4081 |
| | 27 | 16.04 | -184.0 | -169.6 | 11.13 | 6.23 | 15.13 | 906 | 6.58 | 3378 |
| | 28 | 16.60 | -168.6 | -153.6 | 11.71 | 6.29 | 16.96 | 851 | 6.10 | 2692 |
| | 29 | 17.31 | -151.0 | -135.4 | 12.35 | 6.37 | 19.69 | 788 | 5.55 | 2011 |
| | 30 | 18.33 | -129.9 | -113.4 | 13.10 | 6.48 | 24.86 | 709 | 4.89 | 1312 |
| * | 30.567 | 19.18 | -114.9 | -97.7 | 13.62 | 6.59 | 31.35 | 650 | 4.42 | 889 |
| * | 30.567 | 81.40 | 97.2 | 170.5 | 22.39 | 7.67 | 38.61 | 376 | 0.66 | 281 |
| | 31 | 87.69 | 106.9 | 185.8 | 22.89 | 7.46 | 30.61 | 387 | 0.59 | 365 |
| | 32 | 98.65 | 123.4 | 212.1 | 23.73 | 7.18 | 23.21 | 405 | 0.51 | 507 |
| | 33 | 107.77 | 136.6 | 233.6 | 24.39 | 7.01 | 19.86 | 420 | 0.46 | 622 |
| | 34 | 115.89 | 148.1 | 252.4 | 24.95 | 6.83 | 17.88 | 434 | 0.42 | 721 |
| | 35 | 123.40 | 158.5 | 269.6 | 25.45 | 6.71 | 16.57 | 447 | 0.39 | 811 |
| | 36 | 130.48 | 168.2 | 285.7 | 25.90 | 6.63 | 15.64 | 459 | 0.36 | 893 |
| | 37 | 137.24 | 177.4 | 301.0 | 26.32 | 6.57 | 14.94 | 470 | 0.34 | 971 |
| | 38 | 143.76 | 186.2 | 315.6 | 26.71 | 6.52 | 14.40 | 480 | 0.32 | 1044 |
| | 39 | 150.07 | 194.7 | 329.8 | 27.08 | 6.49 | 13.97 | 490 | 0.31 | 1115 |
| | 40 | 156.22 | 203.0 | 343.6 | 27.43 | 6.46 | 13.62 | 499 | 0.29 | 1182 |
| | 42 | 168.13 | 218.9 | 370.3 | 28.08 | 6.43 | 13.08 | 516 | 0.27 | 1311 |
| | 44 | 179.63 | 234.3 | 396.0 | 28.68 | 6.41 | 12.68 | 533 | 0.25 | 1433 |
| | 46 | 190.81 | 249.3 | 421.0 | 29.23 | 6.40 | 12.38 | 548 | 0.24 | 1551 |
| | 48 | 201.75 | 264.0 | 445.6 | 29.76 | 6.40 | 12.15 | 562 | 0.22 | 1663 |
| | 50 | 212.48 | 278.4 | 469.7 | 30.25 | 6.41 | 11.97 | 576 | 0.21 | 1773 |
| | 55 | 238.65 | 314.0 | 528.7 | 31.37 | 6.47 | 11.69 | 607 | 0.18 | 2036 |
| | 60 | 264.10 | 349.1 | 586.8 | 32.39 | 6.58 | 11.57 | 634 | 0.17 | 2286 |
| | 65 | 289.08 | 384.5 | 644.7 | 33.31 | 6.75 | 11.58 | 658 | 0.15 | 2528 |
| | 70 | 313.70 | 420.5 | 702.9 | 34.17 | 6.99 | 11.70 | 680 | 0.14 | 2765 |
| | 75 | 338.05 | 457.6 | 761.9 | 34.99 | 7.29 | 11.91 | 700 | 0.13 | 2996 |
| | 80 | 362.20 | 496.1 | 822.1 | 35.77 | 7.63 | 12.18 | 717 | 0.12 | 3224 |
| | 85 | 386.18 | 536.2 | 883.8 | 36.51 | 8.02 | 12.51 | 734 | 0.11 | 3449 |
| | 90 | 410.02 | 578.3 | 947.3 | 37.24 | 8.43 | 12.88 | 749 | 0.10 | 3672 |
| | 95 | 433.76 | 622.3 | 1012.7 | 37.95 | 8.86 | 13.27 | 763 | 0.10 | 3892 |
| | 100 | 457.41 | 668.4 | 1080.0 | 38.64 | 9.29 | 13.67 | 778 | 0.09 | 4111 |
| | 110 | 504.46 | 766.8 | 1220.8 | 39.98 | 10.13 | 14.45 | 805 | 0.08 | 4545 |
| | 120 | 551.30 | 872.7 | 1369.8 | 41.26 | 10.85 | 15.14 | 833 | 0.08 | 4976 |
| | 130 | 597.96 | 984.9 | 1523.1 | 42.50 | 11.42 | 15.68 | 861 | 0.07 | 5403 |
| | 140 | 644.49 | 1102.0 | 1682.0 | 43.68 | 11.83 | 16.08 | 890 | 0.07 | 5828 |
| | 150 | 690.91 | 1222.3 | 1844.1 | 44.79 | 12.09 | 16.32 | 918 | 0.06 | 6251 |
| | 160 | 737.25 | 1344.4 | 2008.0 | 45.85 | 12.22 | 16.44 | 947 | 0.06 | 6672 |
| | 170 | 783.53 | 1467.3 | 2172.5 | 46.85 | 12.25 | 16.45 | 976 | 0.05 | 7092 |
| | 180 | 829.75 | 1589.9 | 2336.7 | 47.79 | 12.20 | 16.39 | 1005 | 0.05 | 7512 |
| | 190 | 875.92 | 1711.7 | 2500.1 | 48.67 | 12.09 | 16.28 | 1033 | 0.05 | 7930 |
| | 200 | 922.05 | 1832.3 | 2662.1 | 49.50 | 11.95 | 16.13 | 1061 | 0.05 | 8348 |
| | 220 | 1014.23 | 2068.7 | 2981.5 | 51.02 | 11.64 | 15.81 | 1117 | 0.04 | 9182 |
| | 240 | 1106.30 | 2298.8 | 3294.4 | 52.39 | 11.34 | 15.49 | 1170 | 0.04 | 10014 |
| | 260 | 1198.30 | 2523.2 | 3601.6 | 53.62 | 11.08 | 15.23 | 1221 | 0.03 | 10845 |
| | 280 | 1290.24 | 2742.9 | 3904.1 | 54.74 | 10.88 | 15.03 | 1270 | 0.03 | 11675 |
| | 300 | 1382.14 | 2959.1 | 4203.0 | 55.77 | 10.73 | 14.87 | 1317 | 0.03 | 12504 |

* TWO PHASE BOUNDARY

TABLE VI. THERMODYNAMIC PROPERTIES OF PARAHYDROGEN

| | 10 BAR ISOBAR TEMPERATURE K | MOLAR VOLUME $CM^3/G$ | INTERNAL ENERGY J/G | ENTHALPY J/G | ENTROPY J/G-K | SPECIFIC HEAT CV J/G-K | SPECIFIC HEAT CP J/G-K | VELOCITY OF SOUND M/S | $\left(\frac{\partial P}{\partial T}\right)_V$ BAR/K | $\left(\frac{\partial P}{\partial \rho}\right)_T$ BAR-$CM^3$/G |
|---|---|---|---|---|---|---|---|---|---|---|
| * | 14.133 | 12.89 | -309.6 | -295.7 | 4.99 | 4.72 | 6.38 | 1292 | 9.35 | 12345 |
| | 15 | 13.01 | -303.0 | -290.0 | 5.38 | 4.90 | 6.81 | 1270 | 9.34 | 11601 |
| | 16 | 13.15 | -296.1 | -282.9 | 5.84 | 5.09 | 7.27 | 1239 | 9.21 | 10736 |
| | 17 | 13.30 | -288.7 | -275.4 | 6.29 | 5.26 | 7.71 | 1214 | 9.06 | 10057 |
| | 18 | 13.47 | -281.0 | -267.5 | 6.75 | 5.43 | 8.18 | 1191 | 8.91 | 9415 |
| | 19 | 13.65 | -272.7 | -259.1 | 7.20 | 5.57 | 8.66 | 1169 | 8.76 | 8799 |
| | 20 | 13.84 | -264.0 | -250.2 | 7.66 | 5.71 | 9.17 | 1145 | 8.59 | 8156 |
| | 21 | 14.05 | -254.8 | -240.7 | 8.12 | 5.82 | 9.72 | 1121 | 8.41 | 7524 |
| | 22 | 14.28 | -245.0 | -230.7 | 8.58 | 5.92 | 10.32 | 1094 | 8.21 | 6872 |
| | 23 | 14.54 | -234.6 | -220.1 | 9.06 | 6.00 | 10.97 | 1066 | 7.98 | 6220 |
| | 24 | 14.83 | -223.5 | -208.7 | 9.54 | 6.07 | 11.74 | 1035 | 7.71 | 5539 |
| | 25 | 15.15 | -211.7 | -196.6 | 10.04 | 6.13 | 12.53 | 1001 | 7.41 | 4883 |
| | 26 | 15.53 | -199.0 | -183.5 | 10.55 | 6.18 | 13.59 | 962 | 7.06 | 4208 |
| | 27 | 15.97 | -185.3 | -169.3 | 11.08 | 6.23 | 14.84 | 917 | 6.65 | 3532 |
| | 28 | 16.50 | -170.2 | -153.7 | 11.65 | 6.29 | 16.52 | 865 | 6.19 | 2850 |
| | 29 | 17.17 | -153.2 | -136.0 | 12.27 | 6.36 | 19.00 | 804 | 5.66 | 2166 |
| | 30 | 18.09 | -133.2 | -115.1 | 12.98 | 6.46 | 23.26 | 731 | 5.04 | 1485 |
| | 31 | 19.58 | -107.2 | -87.6 | 13.88 | 6.63 | 33.89 | 633 | 4.24 | 784 |
| * | 31.248 | 20.16 | -98.7 | -78.5 | 14.17 | 6.71 | 40.60 | 600 | 3.98 | 594 |
| * | 31.248 | 69.66 | 87.6 | 157.3 | 21.72 | 7.93 | 52.16 | 374 | 0.79 | 213 |
| | 32 | 80.44 | 107.0 | 187.5 | 22.68 | 7.50 | 31.66 | 393 | 0.65 | 367 |
| | 33 | 90.53 | 124.2 | 214.8 | 23.52 | 7.22 | 23.86 | 411 | 0.56 | 511 |
| | 34 | 98.88 | 137.8 | 236.7 | 24.17 | 6.97 | 20.33 | 427 | 0.50 | 627 |
| | 35 | 106.33 | 149.6 | 255.9 | 24.73 | 6.81 | 18.27 | 442 | 0.46 | 728 |
| | 36 | 113.22 | 160.2 | 273.4 | 25.22 | 6.70 | 16.91 | 454 | 0.43 | 819 |
| | 37 | 119.70 | 170.1 | 289.9 | 25.67 | 6.63 | 15.94 | 466 | 0.40 | 903 |
| | 38 | 125.89 | 179.5 | 305.4 | 26.09 | 6.57 | 15.22 | 477 | 0.38 | 982 |
| | 39 | 131.84 | 188.5 | 320.3 | 26.48 | 6.53 | 14.65 | 487 | 0.36 | 1057 |
| | 40 | 137.61 | 197.1 | 334.8 | 26.84 | 6.50 | 14.20 | 497 | 0.34 | 1128 |
| | 42 | 148.71 | 213.7 | 362.4 | 27.52 | 6.45 | 13.52 | 515 | 0.31 | 1264 |
| | 44 | 159.36 | 229.6 | 389.0 | 28.13 | 6.43 | 13.03 | 531 | 0.29 | 1391 |
| | 46 | 169.67 | 245.0 | 414.7 | 28.70 | 6.42 | 12.67 | 547 | 0.27 | 1513 |
| | 48 | 179.72 | 260.0 | 439.7 | 29.24 | 6.42 | 12.40 | 561 | 0.25 | 1630 |
| | 50 | 189.57 | 274.7 | 464.3 | 29.74 | 6.42 | 12.18 | 575 | 0.24 | 1742 |
| | 55 | 213.47 | 310.8 | 524.2 | 30.88 | 6.48 | 11.84 | 606 | 0.21 | 2012 |
| | 60 | 236.65 | 346.4 | 583.0 | 31.91 | 6.59 | 11.69 | 634 | 0.19 | 2267 |
| | 65 | 259.34 | 382.0 | 641.4 | 32.84 | 6.76 | 11.68 | 659 | 0.17 | 2513 |
| | 70 | 281.67 | 418.3 | 700.0 | 33.71 | 7.00 | 11.78 | 681 | 0.15 | 2753 |
| | 75 | 303.73 | 455.6 | 759.3 | 34.53 | 7.29 | 11.97 | 700 | 0.14 | 2987 |
| | 80 | 325.58 | 494.2 | 819.8 | 35.31 | 7.64 | 12.24 | 718 | 0.13 | 3217 |
| | 85 | 347.27 | 534.5 | 881.8 | 36.06 | 8.02 | 12.56 | 734 | 0.12 | 3444 |
| | 90 | 368.82 | 576.7 | 945.5 | 36.79 | 8.44 | 12.92 | 749 | 0.12 | 3668 |
| | 95 | 390.26 | 620.8 | 1011.1 | 37.50 | 8.87 | 13.31 | 764 | 0.11 | 3890 |
| | 100 | 411.61 | 667.0 | 1078.6 | 38.19 | 9.30 | 13.70 | 778 | 0.10 | 4111 |
| | 110 | 454.08 | 765.5 | 1219.6 | 39.53 | 10.13 | 14.48 | 806 | 0.09 | 4547 |
| | 120 | 496.32 | 871.6 | 1367.9 | 40.82 | 10.85 | 15.16 | 834 | 0.09 | 4979 |
| | 130 | 538.40 | 983.9 | 1522.3 | 42.06 | 11.42 | 15.70 | 862 | 0.08 | 5408 |
| | 140 | 580.34 | 1101.0 | 1681.4 | 43.23 | 11.84 | 16.09 | 891 | 0.07 | 5834 |
| | 150 | 622.18 | 1221.4 | 1843.6 | 44.35 | 12.10 | 16.33 | 919 | 0.07 | 6258 |
| | 160 | 663.94 | 1343.7 | 2007.6 | 45.41 | 12.23 | 16.45 | 948 | 0.06 | 6681 |
| | 170 | 705.63 | 1466.6 | 2172.2 | 46.41 | 12.25 | 16.46 | 977 | 0.06 | 7102 |
| | 180 | 747.26 | 1589.3 | 2336.5 | 47.35 | 12.20 | 16.40 | 1005 | 0.06 | 7522 |
| | 190 | 788.85 | 1711.1 | 2500.0 | 48.23 | 12.09 | 16.28 | 1034 | 0.05 | 7941 |
| | 200 | 830.40 | 1831.7 | 2662.1 | 49.06 | 11.96 | 16.14 | 1062 | 0.05 | 8359 |
| | 220 | 913.40 | 2068.2 | 2981.6 | 50.59 | 11.64 | 15.81 | 1117 | 0.05 | 9194 |
| | 240 | 996.31 | 2298.3 | 3294.6 | 51.95 | 11.34 | 15.50 | 1171 | 0.04 | 10027 |
| | 260 | 1079.14 | 2522.8 | 3601.9 | 53.18 | 11.08 | 15.24 | 1222 | 0.04 | 10859 |
| | 280 | 1161.91 | 2742.6 | 3904.5 | 54.30 | 10.88 | 15.03 | 1271 | 0.04 | 11689 |
| | 300 | 1244.64 | 2958.8 | 4203.4 | 55.33 | 10.73 | 14.87 | 1317 | 0.03 | 12519 |

* TWO PHASE BOUNDARY

TABLE VI. THERMODYNAMIC PROPERTIES OF PARAHYDROGEN

| | 12.5 BAR ISOBAR TEMPERATURE K | MOLAR VOLUME $CM^3/G$ | INTERNAL ENERGY J/G | ENTHALPY J/G | ENTROPY J/G-K | SPECIFIC HEAT CV J/G-K | SPECIFIC HEAT CP J/G-K | VELOCITY OF SOUND M/S | $\left(\frac{\partial P}{\partial T}\right)_V$ BAR/K | $\left(\frac{\partial P}{\partial \rho}\right)_T$ BAR-$CM^3/G$ |
|---|---|---|---|---|---|---|---|---|---|---|
| * | 14.215 | 12.87 | -308.5 | -292.4 | 5.00 | 4.73 | 6.39 | 1299 | 9.36 | 12510 |
| | 15 | 12.97 | -303.4 | -287.2 | 5.35 | 4.89 | 6.75 | 1282 | 9.37 | 11918 |
| | 16 | 13.11 | -296.6 | -280.2 | 5.80 | 5.08 | 7.24 | 1251 | 9.29 | 10987 |
| | 17 | 13.26 | -289.4 | -272.8 | 6.25 | 5.25 | 7.67 | 1226 | 9.13 | 10297 |
| | 18 | 13.42 | -281.7 | -264.9 | 6.70 | 5.42 | 8.13 | 1203 | 8.98 | 9649 |
| | 19 | 13.59 | -273.5 | -256.5 | 7.15 | 5.57 | 8.59 | 1181 | 8.83 | 9041 |
| | 20 | 13.78 | -264.9 | -247.7 | 7.61 | 5.70 | 9.09 | 1158 | 8.67 | 8396 |
| | 21 | 13.99 | -255.8 | -238.4 | 8.06 | 5.81 | 9.62 | 1134 | 8.49 | 7773 |
| | 22 | 14.21 | -246.2 | -228.5 | 8.52 | 5.91 | 10.19 | 1108 | 8.29 | 7124 |
| | 23 | 14.46 | -236.0 | -218.0 | 8.99 | 5.99 | 10.81 | 1081 | 8.06 | 6486 |
| | 24 | 14.73 | -225.2 | -206.8 | 9.46 | 6.07 | 11.51 | 1052 | 7.81 | 5836 |
| | 25 | 15.04 | -213.7 | -194.9 | 9.95 | 6.12 | 12.30 | 1019 | 7.52 | 5173 |
| | 26 | 15.39 | -201.4 | -182.2 | 10.45 | 6.17 | 13.21 | 983 | 7.19 | 4520 |
| | 27 | 15.80 | -188.2 | -168.4 | 10.97 | 6.22 | 14.31 | 942 | 6.81 | 3862 |
| | 28 | 16.28 | -173.8 | -153.5 | 11.51 | 6.27 | 15.74 | 895 | 6.38 | 3192 |
| | 29 | 16.87 | -158.0 | -136.9 | 12.09 | 6.33 | 17.62 | 842 | 5.90 | 2546 |
| | 30 | 17.62 | -140.0 | -118.0 | 12.73 | 6.41 | 20.41 | 780 | 5.36 | 1911 |
| | 31 | 18.68 | -118.7 | -95.3 | 13.48 | 6.51 | 25.39 | 705 | 4.72 | 1277 |
| | 32 | 20.47 | -90.1 | -64.5 | 14.45 | 6.72 | 39.00 | 603 | 3.89 | 627 |
| * | 32.746 | 25.12 | -43.4 | -12.0 | 16.07 | 7.83 | 242.52 | 413 | 2.51 | 55 |
| * | 32.746 | 43.03 | 40.9 | 94.7 | 19.33 | 9.18 | 375.55 | 365 | 1.40 | 33 |
| | 33 | 51.74 | 68.2 | 132.8 | 20.49 | 8.50 | 86.56 | 378 | 1.11 | 140 |
| | 34 | 65.28 | 102.6 | 184.2 | 22.03 | 7.55 | 35.79 | 408 | 0.83 | 352 |
| | 35 | 74.02 | 121.9 | 214.4 | 22.91 | 7.15 | 26.12 | 427 | 0.70 | 499 |
| | 36 | 81.15 | 136.8 | 238.2 | 23.58 | 6.93 | 21.92 | 443 | 0.63 | 620 |
| | 37 | 87.46 | 149.5 | 259.9 | 24.14 | 6.79 | 19.52 | 457 | 0.57 | 726 |
| | 38 | 93.26 | 161.0 | 277.5 | 24.64 | 6.69 | 17.94 | 469 | 0.53 | 821 |
| | 39 | 98.70 | 171.5 | 294.9 | 25.09 | 6.63 | 16.82 | 480 | 0.49 | 910 |
| | 40 | 103.87 | 181.4 | 311.3 | 25.51 | 6.58 | 15.99 | 491 | 0.47 | 992 |
| | 42 | 113.62 | 200.0 | 342.0 | 26.26 | 6.52 | 14.82 | 510 | 0.42 | 1146 |
| | 44 | 122.81 | 217.3 | 370.8 | 26.93 | 6.49 | 14.03 | 528 | 0.38 | 1288 |
| | 46 | 131.60 | 233.8 | 398.3 | 27.54 | 6.46 | 13.48 | 544 | 0.35 | 1421 |
| | 48 | 140.08 | 249.7 | 424.8 | 28.10 | 6.46 | 13.06 | 559 | 0.33 | 1547 |
| | 50 | 148.33 | 265.2 | 450.6 | 28.63 | 6.46 | 12.75 | 574 | 0.31 | 1668 |
| | 55 | 168.19 | 302.7 | 512.9 | 29.82 | 6.51 | 12.24 | 606 | 0.27 | 1954 |
| | 60 | 187.27 | 339.3 | 573.4 | 30.87 | 6.61 | 11.99 | 634 | 0.24 | 2221 |
| | 65 | 205.85 | 375.8 | 633.1 | 31.83 | 6.78 | 11.91 | 660 | 0.21 | 2477 |
| | 70 | 224.05 | 412.7 | 692.8 | 32.71 | 7.01 | 11.97 | 682 | 0.20 | 2724 |
| | 75 | 241.98 | 450.5 | 753.0 | 33.54 | 7.31 | 12.13 | 702 | 0.18 | 2965 |
| | 80 | 259.70 | 489.6 | 814.2 | 34.33 | 7.65 | 12.37 | 719 | 0.17 | 3201 |
| | 85 | 277.26 | 530.2 | 876.8 | 35.09 | 8.03 | 12.67 | 736 | 0.16 | 3433 |
| | 90 | 294.67 | 572.6 | 941.0 | 35.82 | 8.44 | 13.02 | 751 | 0.15 | 3661 |
| | 95 | 311.99 | 617.0 | 1007.0 | 36.54 | 8.87 | 13.39 | 766 | 0.14 | 3887 |
| | 100 | 329.21 | 663.4 | 1075.0 | 37.23 | 9.30 | 13.78 | 780 | 0.13 | 4111 |
| | 110 | 363.41 | 762.4 | 1216.7 | 38.58 | 10.14 | 14.54 | 808 | 0.12 | 4553 |
| | 120 | 397.39 | 868.8 | 1365.5 | 39.88 | 10.86 | 15.21 | 836 | 0.11 | 4989 |
| | 130 | 431.21 | 981.4 | 1520.4 | 41.12 | 11.43 | 15.74 | 864 | 0.10 | 5422 |
| | 140 | 464.89 | 1098.8 | 1679.9 | 42.30 | 11.84 | 16.13 | 893 | 0.09 | 5851 |
| | 150 | 498.47 | 1219.3 | 1842.4 | 43.42 | 12.10 | 16.36 | 921 | 0.08 | 6277 |
| | 160 | 531.98 | 1341.8 | 2006.7 | 44.48 | 12.23 | 16.47 | 950 | 0.08 | 6702 |
| | 170 | 565.41 | 1464.8 | 2171.6 | 45.48 | 12.25 | 16.48 | 979 | 0.07 | 7125 |
| | 180 | 598.79 | 1587.6 | 2336.1 | 46.42 | 12.20 | 16.42 | 1008 | 0.07 | 7547 |
| | 190 | 632.13 | 1709.6 | 2499.8 | 47.30 | 12.10 | 16.30 | 1036 | 0.07 | 7968 |
| | 200 | 665.42 | 1830.3 | 2662.0 | 48.14 | 11.96 | 16.15 | 1064 | 0.06 | 8388 |
| | 220 | 731.92 | 2066.9 | 2981.8 | 49.66 | 11.64 | 15.82 | 1120 | 0.06 | 9225 |
| | 240 | 798.32 | 2297.2 | 3295.1 | 51.02 | 11.34 | 15.51 | 1173 | 0.05 | 10060 |
| | 260 | 864.65 | 2521.8 | 3602.6 | 52.26 | 11.08 | 15.25 | 1224 | 0.05 | 10893 |
| | 280 | 930.92 | 2741.7 | 3905.3 | 53.38 | 10.88 | 15.04 | 1273 | 0.04 | 11724 |
| | 300 | 997.15 | 2958.0 | 4204.4 | 54.41 | 10.73 | 14.88 | 1319 | 0.04 | 12555 |

* TWO PHASE BOUNDARY

TABLE VI. THERMODYNAMIC PROPERTIES OF PARAHYDROGEN

15 BAR ISOBAR

| | TEMPERATURE K | MOLAR VOLUME CM3/G | INTERNAL ENERGY J/G | ENTHALPY J/G | ENTROPY J/G-K | SPECIFIC HEAT CV J/G-K | SPECIFIC HEAT CP J/G-K | VELOCITY OF SOUND M/S | $(\partial P/\partial T)_V$ BAR/K | $(\partial P/\partial \rho)_T$ BAR-CM3/G |
|---|---|---|---|---|---|---|---|---|---|---|
| * | 14.296 | 12.85 | -308.4 | -289.1 | 5.00 | 4.74 | 6.38 | 1306 | 9.38 | 12674 |
| | 15 | 12.94 | -303.9 | -284.5 | 5.32 | 4.89 | 6.70 | 1295 | 9.40 | 12228 |
| | 16 | 13.07 | -297.1 | -277.5 | 5.76 | 5.07 | 7.20 | 1263 | 9.36 | 11234 |
| | 17 | 13.22 | -290.0 | -270.1 | 6.21 | 5.25 | 7.62 | 1240 | 9.20 | 10598 |
| | 18 | 13.37 | -282.4 | -262.3 | 6.66 | 5.41 | 8.06 | 1217 | 9.05 | 9939 |
| | 19 | 13.54 | -274.3 | -254.0 | 7.11 | 5.56 | 8.52 | 1194 | 8.90 | 9303 |
| | 20 | 13.73 | -265.8 | -245.2 | 7.56 | 5.69 | 9.00 | 1172 | 8.74 | 8676 |
| | 21 | 13.92 | -256.9 | -236.0 | 8.01 | 5.80 | 9.51 | 1148 | 8.56 | 8045 |
| | 22 | 14.14 | -247.4 | -226.2 | 8.47 | 5.90 | 10.06 | 1123 | 8.36 | 7408 |
| | 23 | 14.38 | -237.4 | -215.8 | 8.93 | 5.99 | 10.65 | 1097 | 8.15 | 6765 |
| | 24 | 14.64 | -226.8 | -204.8 | 9.39 | 6.06 | 11.32 | 1068 | 7.90 | 6103 |
| | 25 | 14.93 | -215.6 | -193.2 | 9.87 | 6.12 | 12.05 | 1037 | 7.62 | 5467 |
| | 26 | 15.27 | -203.6 | -180.7 | 10.36 | 6.17 | 12.91 | 1003 | 7.31 | 4806 |
| | 27 | 15.64 | -190.8 | -167.3 | 10.86 | 6.22 | 13.84 | 966 | 6.95 | 4191 |
| | 28 | 16.08 | -177.1 | -152.9 | 11.39 | 6.26 | 15.05 | 923 | 6.56 | 3545 |
| | 29 | 16.61 | -162.1 | -137.2 | 11.94 | 6.32 | 16.60 | 874 | 6.11 | 2909 |
| | 30 | 17.26 | -145.5 | -119.6 | 12.54 | 6.38 | 18.68 | 820 | 5.62 | 2295 |
| | 31 | 18.10 | -126.6 | -99.4 | 13.20 | 6.45 | 21.93 | 757 | 5.07 | 1686 |
| | 32 | 19.31 | -104.0 | -75.0 | 13.97 | 6.57 | 27.62 | 682 | 4.42 | 1106 |
| | 33 | 21.40 | -73.3 | -41.2 | 15.01 | 6.80 | 42.99 | 581 | 3.58 | 534 |
| | 34 | 30.16 | -1.9 | 43.4 | 17.53 | 8.76 | 174.98 | 395 | 2.05 | 78 |
| | 35 | 48.84 | 77.1 | 150.4 | 20.64 | 7.70 | 54.07 | 415 | 1.17 | 245 |
| | 36 | 57.99 | 104.8 | 191.8 | 21.81 | 7.27 | 33.56 | 434 | 0.94 | 408 |
| | 37 | 64.95 | 123.8 | 221.2 | 22.61 | 7.02 | 26.25 | 450 | 0.82 | 542 |
| | 38 | 70.82 | 138.9 | 245.1 | 23.25 | 6.85 | 22.60 | 465 | 0.74 | 657 |
| | 39 | 76.14 | 152.0 | 266.2 | 23.80 | 6.74 | 20.01 | 475 | 0.67 | 761 |
| | 40 | 81.06 | 163.8 | 285.4 | 24.29 | 6.67 | 18.44 | 487 | 0.62 | 857 |
| | 42 | 90.07 | 185.0 | 320.1 | 25.13 | 6.59 | 16.45 | 508 | 0.55 | 1030 |
| | 44 | 98.37 | 204.1 | 351.7 | 25.87 | 6.53 | 15.23 | 526 | 0.49 | 1187 |
| | 46 | 106.19 | 222.0 | 381.3 | 26.53 | 6.51 | 14.40 | 543 | 0.45 | 1331 |
| | 48 | 113.66 | 239.0 | 409.5 | 27.13 | 6.50 | 13.81 | 559 | 0.42 | 1468 |
| | 50 | 120.87 | 255.3 | 436.6 | 27.68 | 6.50 | 13.37 | 573 | 0.39 | 1597 |
| | 55 | 138.05 | 294.4 | 501.5 | 28.92 | 6.54 | 12.66 | 606 | 0.33 | 1899 |
| | 60 | 154.41 | 332.2 | 563.9 | 30.00 | 6.64 | 12.30 | 635 | 0.29 | 2178 |
| | 65 | 170.24 | 369.5 | 624.9 | 30.98 | 6.80 | 12.15 | 661 | 0.26 | 2444 |
| | 70 | 185.69 | 407.1 | 685.6 | 31.88 | 7.03 | 12.16 | 683 | 0.24 | 2699 |
| | 75 | 200.86 | 445.4 | 746.7 | 32.72 | 7.32 | 12.29 | 703 | 0.22 | 2946 |
| | 80 | 215.83 | 484.9 | 808.6 | 33.52 | 7.66 | 12.50 | 721 | 0.20 | 3187 |
| | 85 | 230.62 | 525.9 | 871.8 | 34.29 | 8.04 | 12.79 | 738 | 0.19 | 3423 |
| | 90 | 245.28 | 568.6 | 936.6 | 35.03 | 8.45 | 13.12 | 753 | 0.18 | 3656 |
| | 95 | 259.84 | 613.3 | 1003.1 | 35.75 | 8.83 | 13.48 | 768 | 0.17 | 3885 |
| | 100 | 274.30 | 659.9 | 1071.4 | 36.45 | 9.31 | 13.86 | 782 | 0.16 | 4112 |
| | 110 | 302.99 | 759.4 | 1213.8 | 37.80 | 10.14 | 14.60 | 810 | 0.14 | 4559 |
| | 120 | 331.46 | 866.0 | 1363.2 | 39.10 | 10.86 | 15.26 | 838 | 0.13 | 5000 |
| | 130 | 359.76 | 978.9 | 1518.6 | 40.35 | 11.43 | 15.78 | 866 | 0.12 | 5436 |
| | 140 | 387.94 | 1096.5 | 1678.4 | 41.53 | 11.85 | 16.16 | 895 | 0.11 | 5868 |
| | 150 | 416.02 | 1217.3 | 1841.3 | 42.66 | 12.10 | 16.39 | 923 | 0.10 | 6297 |
| | 160 | 444.01 | 1339.8 | 2005.9 | 43.72 | 12.23 | 16.50 | 952 | 0.10 | 6724 |
| | 170 | 471.94 | 1463.0 | 2171.0 | 44.72 | 12.25 | 16.51 | 981 | 0.09 | 7150 |
| | 180 | 499.82 | 1586.0 | 2335.7 | 45.66 | 12.20 | 16.44 | 1010 | 0.08 | 7573 |
| | 190 | 527.65 | 1708.1 | 2499.6 | 46.54 | 12.10 | 16.32 | 1038 | 0.08 | 7995 |
| | 200 | 555.45 | 1828.9 | 2662.0 | 47.38 | 11.96 | 16.17 | 1067 | 0.08 | 8416 |
| | 220 | 610.94 | 2065.7 | 2982.1 | 48.90 | 11.65 | 15.84 | 1122 | 0.07 | 9256 |
| | 240 | 666.34 | 2296.1 | 3295.6 | 50.27 | 11.34 | 15.52 | 1175 | 0.06 | 10092 |
| | 260 | 721.66 | 2520.8 | 3603.3 | 51.50 | 11.09 | 15.25 | 1226 | 0.06 | 10927 |
| | 280 | 776.94 | 2740.8 | 3906.2 | 52.62 | 10.88 | 15.04 | 1275 | 0.05 | 11760 |
| | 300 | 832.16 | 2957.2 | 4205.4 | 53.65 | 10.73 | 14.89 | 1322 | 0.05 | 12592 |

* TWO PHASE BOUNDARY

TABLE VI. THERMODYNAMIC PROPERTIES OF PARAHYDROGEN

| 20 BAR ISOBAR TEMPERATURE K | MOLAR VOLUME $CM^3/G$ | INTERNAL ENERGY J/G | ENTHALPY J/G | ENTROPY J/G-K | SPECIFIC HEAT CV J/G-K | SPECIFIC HEAT CP J/G-K | VELOCITY OF SOUND M/S | $\left(\frac{\partial P}{\partial T}\right)_V$ BAR/K | $\left(\frac{\partial P}{\partial \rho}\right)_T$ BAR-$CM^3$/G |
|---|---|---|---|---|---|---|---|---|---|
| * 14.457 | 12.80 | -308.1 | -282.5 | 5.01 | 4.77 | 6.38 | 1319 | 9.41 | 12996 |
| 15 | 12.87 | -304.7 | -279.0 | 5.25 | 4.83 | 6.63 | 1311 | 9.45 | 12651 |
| 16 | 13.00 | -298.1 | -272.1 | 5.70 | 5.05 | 7.09 | 1288 | 9.43 | 11851 |
| 17 | 13.14 | -291.1 | -264.8 | 6.14 | 5.24 | 7.53 | 1264 | 9.32 | 11097 |
| 18 | 13.29 | -283.6 | -257.1 | 6.58 | 5.40 | 7.96 | 1240 | 9.18 | 10415 |
| 19 | 13.45 | -275.8 | -248.9 | 7.02 | 5.54 | 8.41 | 1218 | 9.03 | 9771 |
| 20 | 13.62 | -267.5 | -240.2 | 7.47 | 5.67 | 8.86 | 1196 | 8.87 | 9158 |
| 21 | 13.81 | -258.8 | -231.1 | 7.91 | 5.79 | 9.34 | 1173 | 8.70 | 8528 |
| 22 | 14.01 | -249.6 | -221.5 | 8.36 | 5.89 | 9.85 | 1150 | 8.51 | 7909 |
| 23 | 14.23 | -239.9 | -211.4 | 8.81 | 5.98 | 10.39 | 1125 | 8.31 | 7273 |
| 24 | 14.47 | -229.7 | -200.8 | 9.25 | 6.05 | 10.98 | 1098 | 8.08 | 6647 |
| 25 | 14.74 | -218.9 | -189.4 | 9.72 | 6.11 | 11.63 | 1070 | 7.82 | 6022 |
| 26 | 15.04 | -207.6 | -177.5 | 10.19 | 6.17 | 12.35 | 1039 | 7.53 | 5393 |
| 27 | 15.38 | -195.5 | -164.7 | 10.67 | 6.21 | 13.15 | 1006 | 7.21 | 4780 |
| 28 | 15.76 | -182.7 | -151.1 | 11.17 | 6.26 | 14.08 | 969 | 6.86 | 4174 |
| 29 | 16.19 | -168.9 | -136.5 | 11.68 | 6.30 | 15.17 | 929 | 6.47 | 3586 |
| 30 | 16.71 | -154.1 | -120.7 | 12.22 | 6.34 | 16.57 | 884 | 6.05 | 2994 |
| 31 | 17.34 | -137.9 | -103.3 | 12.79 | 6.40 | 18.37 | 835 | 5.59 | 2430 |
| 32 | 18.12 | -119.9 | -83.7 | 13.41 | 6.46 | 20.90 | 780 | 5.08 | 1881 |
| 33 | 19.15 | -99.4 | -61.1 | 14.10 | 6.54 | 24.61 | 719 | 4.53 | 1373 |
| 34 | 20.62 | -75.0 | -33.8 | 14.92 | 6.67 | 30.65 | 649 | 3.90 | 915 |
| 35 | 23.03 | -43.9 | 2.1 | 15.96 | 6.99 | 42.22 | 568 | 3.17 | 526 |
| 36 | 27.52 | -2.1 | 53.0 | 17.39 | 7.30 | 59.51 | 494 | 2.39 | 300 |
| 37 | 34.60 | 43.8 | 113.0 | 19.34 | 7.32 | 54.87 | 466 | 1.76 | 290 |
| 38 | 41.38 | 77.1 | 159.9 | 20.29 | 7.23 | 40.86 | 468 | 1.42 | 388 |
| 39 | 47.12 | 101.6 | 195.8 | 21.22 | 7.06 | 31.87 | 477 | 1.20 | 505 |
| 40 | 52.07 | 120.7 | 224.9 | 21.96 | 6.92 | 26.66 | 488 | 1.06 | 618 |
| 42 | 60.55 | 150.9 | 272.0 | 23.11 | 6.73 | 21.10 | 508 | 0.88 | 824 |
| 44 | 67.77 | 175.1 | 310.6 | 24.01 | 6.62 | 18.34 | 527 | 0.76 | 1002 |
| 46 | 74.47 | 196.5 | 345.5 | 24.78 | 6.58 | 16.66 | 544 | 0.68 | 1169 |
| 48 | 80.72 | 216.2 | 377.6 | 25.47 | 6.57 | 15.56 | 560 | 0.62 | 1324 |
| 50 | 86.64 | 234.6 | 407.9 | 26.09 | 6.56 | 14.78 | 575 | 0.57 | 1469 |
| 55 | 100.51 | 277.5 | 478.5 | 27.43 | 6.60 | 13.58 | 609 | 0.48 | 1801 |
| 60 | 113.46 | 317.8 | 544.7 | 28.58 | 6.68 | 12.94 | 638 | 0.41 | 2103 |
| 65 | 125.85 | 356.9 | 608.6 | 29.61 | 6.84 | 12.64 | 664 | 0.37 | 2386 |
| 70 | 137.86 | 395.8 | 671.5 | 30.54 | 7.06 | 12.55 | 687 | 0.33 | 2655 |
| 75 | 149.57 | 435.2 | 734.3 | 31.41 | 7.34 | 12.60 | 707 | 0.30 | 2914 |
| 80 | 161.08 | 475.5 | 797.7 | 32.22 | 7.69 | 12.77 | 725 | 0.28 | 3165 |
| 85 | 172.42 | 517.3 | 862.1 | 33.01 | 8.06 | 13.01 | 742 | 0.26 | 3410 |
| 90 | 183.62 | 560.7 | 927.9 | 33.76 | 8.47 | 13.31 | 757 | 0.24 | 3650 |
| 95 | 194.72 | 605.9 | 995.3 | 34.49 | 8.89 | 13.65 | 772 | 0.23 | 3886 |
| 100 | 205.73 | 653.0 | 1064.4 | 35.20 | 9.32 | 14.00 | 787 | 0.21 | 4119 |
| 110 | 227.52 | 753.2 | 1208.3 | 36.56 | 10.16 | 14.72 | 814 | 0.19 | 4576 |
| 120 | 249.09 | 860.6 | 1358.8 | 37.87 | 10.87 | 15.36 | 842 | 0.17 | 5025 |
| 130 | 270.50 | 974.0 | 1515.0 | 39.12 | 11.44 | 15.87 | 871 | 0.16 | 5467 |
| 140 | 291.79 | 1092.0 | 1675.6 | 40.31 | 11.85 | 16.23 | 899 | 0.15 | 5905 |
| 150 | 312.98 | 1213.2 | 1839.1 | 41.44 | 12.11 | 16.45 | 928 | 0.14 | 6339 |
| 160 | 334.09 | 1336.1 | 2004.3 | 42.51 | 12.24 | 16.55 | 957 | 0.13 | 6771 |
| 170 | 355.13 | 1459.6 | 2169.8 | 43.51 | 12.26 | 16.55 | 986 | 0.12 | 7199 |
| 180 | 376.13 | 1582.8 | 2335.0 | 44.46 | 12.21 | 16.48 | 1014 | 0.11 | 7626 |
| 190 | 397.08 | 1705.1 | 2499.2 | 45.34 | 12.10 | 16.35 | 1043 | 0.11 | 8051 |
| 200 | 417.99 | 1826.0 | 2662.0 | 46.18 | 11.97 | 16.20 | 1071 | 0.10 | 8475 |
| 220 | 459.73 | 2063.2 | 2982.7 | 47.71 | 11.65 | 15.86 | 1126 | 0.09 | 9318 |
| 240 | 501.37 | 2293.9 | 3296.7 | 49.07 | 11.35 | 15.54 | 1180 | 0.08 | 10159 |
| 260 | 542.94 | 2518.8 | 3604.7 | 50.31 | 11.09 | 15.27 | 1231 | 0.08 | 10996 |
| 280 | 584.45 | 2739.0 | 3908.0 | 51.43 | 10.89 | 15.06 | 1279 | 0.07 | 11831 |
| 300 | 625.93 | 2955.6 | 4207.5 | 52.46 | 10.73 | 14.90 | 1326 | 0.07 | 12665 |

* TWO PHASE BOUNDARY

TABLE VI. THERMODYNAMIC PROPERTIES OF PARAHYDROGEN

25 BAR ISOBAR

| | TEMPERATURE K | MOLAR VOLUME CM3/G | INTERNAL ENERGY J/G | ENTHALPY J/G | ENTROPY J/G-K | SPECIFIC HEAT CV J/G-K | SPECIFIC HEAT CP J/G-K | VELOCITY OF SOUND M/S | $\left(\frac{\partial P}{\partial T}\right)_V$ BAR/K | $\left(\frac{\partial P}{\partial \rho}\right)_T$ BAR-CM3/G |
|---|---|---|---|---|---|---|---|---|---|---|
| * | 14.615 | 12.76 | -307.8 | -275.9 | 5.03 | 4.79 | 6.38 | 1332 | 9.44 | 13313 |
| | 15 | 12.80 | -305.5 | -273.4 | 5.19 | 4.87 | 6.55 | 1329 | 9.47 | 13127 |
| | 16 | 12.93 | -299.0 | -266.7 | 5.63 | 5.06 | 7.00 | 1310 | 9.50 | 12384 |
| | 17 | 13.06 | -292.1 | -259.4 | 6.07 | 5.23 | 7.46 | 1285 | 9.44 | 11576 |
| | 18 | 13.20 | -284.8 | -251.8 | 6.51 | 5.38 | 7.87 | 1264 | 9.30 | 10931 |
| | 19 | 13.36 | -277.1 | -243.7 | 6.94 | 5.53 | 8.29 | 1241 | 9.15 | 10273 |
| | 20 | 13.52 | -269.0 | -235.2 | 7.38 | 5.66 | 8.73 | 1220 | 9.00 | 9642 |
| | 21 | 13.70 | -260.5 | -226.2 | 7.82 | 5.77 | 9.18 | 1198 | 8.84 | 9030 |
| | 22 | 13.89 | -251.6 | -216.8 | 8.25 | 5.88 | 9.66 | 1176 | 8.65 | 8412 |
| | 23 | 14.10 | -242.2 | -206.9 | 8.69 | 5.96 | 10.16 | 1152 | 8.46 | 7796 |
| | 24 | 14.32 | -232.3 | -196.5 | 9.14 | 6.04 | 10.70 | 1127 | 8.24 | 7171 |
| | 25 | 14.57 | -221.9 | -185.5 | 9.59 | 6.11 | 11.28 | 1100 | 7.99 | 6555 |
| | 26 | 14.84 | -211.0 | -173.9 | 10.04 | 6.16 | 11.92 | 1072 | 7.73 | 5936 |
| | 27 | 15.15 | -199.5 | -161.6 | 10.50 | 6.21 | 12.60 | 1042 | 7.43 | 5349 |
| | 28 | 15.48 | -187.4 | -148.7 | 10.98 | 6.25 | 13.37 | 1009 | 7.11 | 4768 |
| | 29 | 15.86 | -174.5 | -134.9 | 11.46 | 6.29 | 14.25 | 974 | 6.76 | 4193 |
| | 30 | 16.30 | -160.9 | -120.1 | 11.96 | 6.33 | 15.31 | 935 | 6.39 | 3619 |
| | 31 | 16.81 | -146.2 | -104.2 | 12.48 | 6.37 | 16.52 | 895 | 5.98 | 3089 |
| | 32 | 17.40 | -130.5 | -87.0 | 13.03 | 6.42 | 18.07 | 850 | 5.55 | 2567 |
| | 33 | 18.13 | -113.2 | -67.9 | 13.62 | 6.47 | 20.07 | 802 | 5.10 | 2072 |
| | 34 | 19.04 | -94.3 | -46.6 | 14.25 | 6.53 | 22.59 | 750 | 4.60 | 1628 |
| | 35 | 20.23 | -72.9 | -22.4 | 14.95 | 6.62 | 26.06 | 695 | 4.08 | 1226 |
| | 36 | 21.84 | -48.6 | 6.0 | 15.75 | 6.73 | 30.80 | 638 | 3.53 | 888 |
| | 37 | 24.11 | -20.7 | 39.6 | 16.67 | 6.88 | 36.58 | 586 | 2.98 | 645 |
| | 38 | 27.24 | 10.1 | 78.2 | 17.70 | 7.05 | 40.39 | 540 | 2.45 | 509 |
| | 39 | 31.15 | 41.0 | 118.8 | 18.76 | 7.14 | 39.99 | 517 | 2.04 | 478 |
| | 40 | 35.31 | 68.0 | 156.3 | 19.71 | 7.06 | 35.52 | 513 | 1.73 | 523 |
| | 42 | 43.05 | 110.7 | 218.3 | 21.22 | 6.91 | 27.10 | 520 | 1.34 | 690 |
| | 44 | 49.77 | 142.8 | 267.2 | 22.36 | 6.78 | 22.20 | 534 | 1.11 | 872 |
| | 46 | 55.76 | 169.1 | 308.5 | 23.28 | 6.69 | 19.31 | 550 | 0.96 | 1048 |
| | 48 | 61.25 | 192.0 | 345.2 | 24.06 | 6.64 | 17.49 | 565 | 0.85 | 1213 |
| | 50 | 66.32 | 212.8 | 378.6 | 24.74 | 6.63 | 16.29 | 579 | 0.77 | 1365 |
| | 55 | 78.17 | 259.9 | 455.4 | 26.21 | 6.66 | 14.57 | 614 | 0.64 | 1721 |
| | 60 | 89.06 | 303.1 | 525.7 | 27.43 | 6.73 | 13.62 | 643 | 0.54 | 2042 |
| | 65 | 99.37 | 344.1 | 592.5 | 28.50 | 6.88 | 13.15 | 669 | 0.48 | 2340 |
| | 70 | 109.29 | 384.4 | 657.6 | 29.47 | 7.09 | 12.94 | 692 | 0.43 | 2621 |
| | 75 | 118.92 | 424.9 | 722.2 | 30.36 | 7.37 | 12.92 | 712 | 0.39 | 2891 |
| | 80 | 128.34 | 466.2 | 787.1 | 31.20 | 7.70 | 13.03 | 730 | 0.36 | 3151 |
| | 85 | 137.59 | 508.7 | 852.7 | 31.99 | 8.09 | 13.23 | 747 | 0.33 | 3404 |
| | 90 | 146.72 | 552.7 | 919.5 | 32.75 | 8.49 | 13.50 | 762 | 0.31 | 3651 |
| | 95 | 155.74 | 598.5 | 987.8 | 33.49 | 8.90 | 13.81 | 777 | 0.29 | 3893 |
| | 100 | 164.67 | 646.0 | 1057.7 | 34.21 | 9.33 | 14.15 | 792 | 0.27 | 4131 |
| | 110 | 182.30 | 747.2 | 1202.9 | 35.59 | 10.17 | 14.84 | 819 | 0.24 | 4597 |
| | 120 | 199.72 | 855.2 | 1354.5 | 36.91 | 10.88 | 15.45 | 847 | 0.22 | 5053 |
| | 130 | 216.99 | 969.1 | 1511.6 | 38.17 | 11.45 | 15.95 | 875 | 0.20 | 5502 |
| | 140 | 234.14 | 1087.6 | 1672.9 | 39.36 | 11.86 | 16.30 | 904 | 0.19 | 5945 |
| | 150 | 251.19 | 1209.1 | 1837.1 | 40.50 | 12.12 | 16.51 | 932 | 0.17 | 6384 |
| | 160 | 268.16 | 1332.3 | 2002.7 | 41.56 | 12.25 | 16.60 | 961 | 0.16 | 6819 |
| | 170 | 285.07 | 1456.1 | 2168.8 | 42.57 | 12.27 | 16.60 | 990 | 0.15 | 7251 |
| | 180 | 301.93 | 1579.6 | 2334.4 | 43.52 | 12.22 | 16.52 | 1019 | 0.14 | 7681 |
| | 190 | 318.75 | 1702.1 | 2499.0 | 44.41 | 12.11 | 16.39 | 1047 | 0.13 | 8108 |
| | 200 | 335.53 | 1823.3 | 2662.1 | 45.24 | 11.97 | 16.23 | 1076 | 0.13 | 8534 |
| | 220 | 369.01 | 2060.8 | 2983.3 | 46.77 | 11.66 | 15.89 | 1131 | 0.12 | 9382 |
| | 240 | 402.39 | 2291.8 | 3297.8 | 48.14 | 11.35 | 15.56 | 1184 | 0.11 | 10226 |
| | 260 | 435.71 | 2516.9 | 3606.2 | 49.38 | 11.09 | 15.29 | 1235 | 0.10 | 11066 |
| | 280 | 468.97 | 2737.3 | 3909.7 | 50.50 | 10.89 | 15.08 | 1284 | 0.09 | 11903 |
| | 300 | 502.19 | 2954.1 | 4209.5 | 51.54 | 10.74 | 14.91 | 1330 | 0.08 | 12739 |

* TWO PHASE BOUNDARY

TABLE VI. THERMODYNAMIC PROPERTIES OF PARAHYDROGEN

| 30 BAR ISOBAR TEMPERATURE K | MOLAR VOLUME $CM^3/G$ | INTERNAL ENERGY J/G | ENTHALPY J/G | ENTROPY J/G-K | SPECIFIC HEAT CV J/G-K | SPECIFIC HEAT CP J/G-K | VELOCITY OF SOUND M/S | $\left(\frac{\partial P}{\partial T}\right)_V$ BAR/K | $\left(\frac{\partial P}{\partial \rho}\right)_T$ BAR-$CM^3/G$ |
|---|---|---|---|---|---|---|---|---|---|
| * 14.772 | 12.72 | -307.6 | -269.4 | 5.04 | 4.81 | 6.38 | 1345 | 9.47 | 13624 |
| 15 | 12.74 | -306.2 | -267.9 | 5.14 | 4.86 | 6.47 | 1345 | 9.49 | 13586 |
| 16 | 12.86 | -299.8 | -261.2 | 5.57 | 5.05 | 6.93 | 1326 | 9.54 | 12795 |
| 17 | 12.99 | -293.1 | -254.1 | 6.00 | 5.22 | 7.37 | 1306 | 9.51 | 12076 |
| 18 | 13.13 | -285.9 | -246.5 | 6.43 | 5.37 | 7.78 | 1285 | 9.40 | 11409 |
| 19 | 13.27 | -278.3 | -238.5 | 6.87 | 5.52 | 8.20 | 1262 | 9.27 | 10732 |
| 20 | 13.43 | -270.4 | -230.1 | 7.30 | 5.65 | 8.62 | 1241 | 9.12 | 10094 |
| 21 | 13.60 | -262.1 | -221.3 | 7.73 | 5.76 | 9.05 | 1221 | 8.96 | 9489 |
| 22 | 13.78 | -253.4 | -212.0 | 8.16 | 5.86 | 9.50 | 1199 | 8.79 | 8876 |
| 23 | 13.98 | -244.2 | -202.3 | 8.59 | 5.95 | 9.97 | 1177 | 8.59 | 8272 |
| 24 | 14.19 | -234.7 | -192.1 | 9.02 | 6.03 | 10.47 | 1153 | 8.39 | 7656 |
| 25 | 14.42 | -224.6 | -181.4 | 9.46 | 6.10 | 11.00 | 1128 | 8.16 | 7054 |
| 26 | 14.67 | -214.1 | -170.1 | 9.90 | 6.15 | 11.57 | 1102 | 7.90 | 6462 |
| 27 | 14.94 | -203.1 | -158.2 | 10.35 | 6.21 | 12.17 | 1074 | 7.63 | 5885 |
| 28 | 15.25 | -191.5 | -145.7 | 10.81 | 6.26 | 12.84 | 1044 | 7.33 | 5316 |
| 29 | 15.59 | -179.3 | -132.5 | 11.27 | 6.29 | 13.57 | 1013 | 7.01 | 4762 |
| 30 | 15.97 | -166.4 | -118.5 | 11.74 | 6.33 | 14.39 | 980 | 6.67 | 4223 |
| 31 | 16.40 | -152.9 | -103.7 | 12.23 | 6.36 | 15.36 | 943 | 6.31 | 3688 |
| 32 | 16.89 | -138.5 | -87.8 | 12.74 | 6.40 | 16.47 | 905 | 5.93 | 3184 |
| 33 | 17.47 | -123.1 | -70.7 | 13.26 | 6.44 | 17.83 | 864 | 5.52 | 2699 |
| 34 | 18.15 | -106.6 | -52.1 | 13.82 | 6.48 | 19.38 | 822 | 5.10 | 2258 |
| 35 | 18.97 | -88.7 | -31.8 | 14.41 | 6.53 | 21.25 | 778 | 4.66 | 1858 |
| 36 | 19.97 | -69.4 | -9.4 | 15.04 | 6.59 | 23.56 | 732 | 4.21 | 1498 |
| 37 | 21.23 | -48.3 | 15.4 | 15.72 | 6.66 | 26.24 | 686 | 3.75 | 1196 |
| 38 | 22.82 | -25.5 | 43.0 | 16.45 | 6.75 | 28.93 | 644 | 3.29 | 967 |
| 39 | 24.80 | -1.2 | 73.2 | 17.23 | 6.84 | 31.20 | 607 | 2.87 | 809 |
| 40 | 27.17 | 23.6 | 105.1 | 18.04 | 6.91 | 32.44 | 580 | 2.49 | 718 |
| 42 | 32.74 | 69.9 | 168.1 | 19.58 | 6.93 | 30.17 | 556 | 1.92 | 711 |
| 44 | 38.42 | 108.5 | 223.8 | 20.88 | 6.86 | 25.57 | 556 | 1.55 | 830 |
| 46 | 43.69 | 140.0 | 271.1 | 21.93 | 6.79 | 22.01 | 565 | 1.31 | 984 |
| 48 | 48.57 | 166.8 | 312.5 | 22.81 | 6.73 | 19.56 | 576 | 1.14 | 1144 |
| 50 | 53.12 | 190.5 | 349.9 | 23.57 | 6.70 | 17.90 | 589 | 1.02 | 1299 |
| 55 | 63.49 | 242.1 | 432.6 | 25.15 | 6.71 | 15.49 | 620 | 0.81 | 1663 |
| 60 | 72.96 | 288.2 | 507.1 | 26.45 | 6.77 | 14.31 | 649 | 0.69 | 1998 |
| 65 | 81.86 | 331.2 | 576.8 | 27.57 | 6.91 | 13.65 | 675 | 0.60 | 2307 |
| 70 | 90.36 | 373.1 | 644.2 | 28.57 | 7.12 | 13.33 | 698 | 0.53 | 2599 |
| 75 | 98.59 | 414.7 | 710.5 | 29.48 | 7.39 | 13.24 | 718 | 0.48 | 2877 |
| 80 | 106.60 | 457.0 | 776.8 | 30.34 | 7.72 | 13.29 | 736 | 0.44 | 3145 |
| 85 | 114.46 | 500.2 | 843.6 | 31.15 | 8.09 | 13.45 | 752 | 0.40 | 3405 |
| 90 | 122.19 | 544.9 | 911.4 | 31.92 | 8.53 | 13.69 | 768 | 0.38 | 3658 |
| 95 | 129.81 | 591.1 | 980.6 | 32.67 | 8.92 | 13.98 | 782 | 0.35 | 3906 |
| 100 | 137.35 | 639.2 | 1051.2 | 33.39 | 9.34 | 14.29 | 797 | 0.33 | 4149 |
| 110 | 152.20 | 741.2 | 1197.8 | 34.79 | 10.18 | 14.96 | 824 | 0.29 | 4622 |
| 120 | 166.85 | 849.9 | 1350.4 | 36.12 | 10.90 | 15.55 | 852 | 0.27 | 5085 |
| 130 | 181.35 | 964.3 | 1508.4 | 37.38 | 11.46 | 16.02 | 880 | 0.24 | 5540 |
| 140 | 195.73 | 1083.2 | 1670.4 | 38.58 | 11.87 | 16.37 | 908 | 0.22 | 5988 |
| 150 | 210.02 | 1205.1 | 1835.2 | 39.72 | 12.13 | 16.57 | 937 | 0.21 | 6430 |
| 160 | 224.23 | 1328.7 | 2001.4 | 40.79 | 12.25 | 16.65 | 966 | 0.19 | 6869 |
| 170 | 238.38 | 1452.7 | 2167.9 | 41.80 | 12.23 | 16.64 | 995 | 0.18 | 7305 |
| 180 | 252.49 | 1576.4 | 2333.9 | 42.75 | 12.22 | 16.55 | 1024 | 0.17 | 7737 |
| 190 | 266.55 | 1699.1 | 2498.8 | 43.64 | 12.12 | 16.42 | 1052 | 0.16 | 8167 |
| 200 | 280.57 | 1820.5 | 2662.2 | 44.48 | 11.98 | 16.26 | 1080 | 0.15 | 8595 |
| 220 | 308.54 | 2058.4 | 2984.0 | 46.01 | 11.66 | 15.91 | 1135 | 0.14 | 9447 |
| 240 | 336.42 | 2289.6 | 3298.9 | 47.38 | 11.35 | 15.58 | 1189 | 0.13 | 10294 |
| 260 | 364.23 | 2515.0 | 3607.7 | 48.62 | 11.10 | 15.31 | 1239 | 0.12 | 11136 |
| 280 | 391.99 | 2735.6 | 3911.6 | 49.74 | 10.89 | 15.09 | 1288 | 0.11 | 11976 |
| 300 | 419.70 | 2952.5 | 4211.6 | 50.78 | 10.74 | 14.93 | 1334 | 0.10 | 12813 |

* TWO PHASE BOUNDARY

TABLE VI. THERMODYNAMIC PROPERTIES OF PARAHYDROGEN

| 35 BAR ISOBAR TEMPERATURE K | MOLAR VOLUME $CM^3/G$ | INTERNAL ENERGY J/G | ENTHALPY J/G | ENTROPY J/G-K | SPECIFIC HEAT CV J/G-K | SPECIFIC HEAT CP J/G-K | VELOCITY OF SOUND M/S | $\left(\frac{\partial P}{\partial T}\right)_V$ BAR/K | $\left(\frac{\partial P}{\partial \rho}\right)_T$ BAR-$CM^3$/G |
|---|---|---|---|---|---|---|---|---|---|
| * 14.927 | 12.68 | -307.3 | -262.9 | 5.05 | 4.83 | 6.38 | 1357 | 9.50 | 13930 |
| 15 | 12.68 | -306.8 | -262.4 | 5.08 | 4.84 | 6.41 | 1358 | 9.50 | 13952 |
| 16 | 12.80 | -300.6 | -255.8 | 5.51 | 5.04 | 6.85 | 1342 | 9.58 | 13239 |
| 17 | 12.92 | -293.9 | -248.7 | 5.94 | 5.21 | 7.29 | 1324 | 9.57 | 12540 |
| 18 | 13.05 | -286.9 | -241.2 | 6.36 | 5.37 | 7.71 | 1304 | 9.51 | 11851 |
| 19 | 13.20 | -279.5 | -233.3 | 6.79 | 5.51 | 8.10 | 1284 | 9.37 | 11225 |
| 20 | 13.34 | -271.7 | -225.0 | 7.22 | 5.64 | 8.51 | 1263 | 9.23 | 10578 |
| 21 | 13.51 | -263.6 | -216.3 | 7.64 | 5.75 | 8.92 | 1243 | 9.07 | 9959 |
| 22 | 13.69 | -255.0 | -207.2 | 8.07 | 5.86 | 9.35 | 1222 | 8.91 | 9358 |
| 23 | 13.86 | -246.1 | -197.6 | 8.49 | 5.95 | 9.79 | 1201 | 8.73 | 8760 |
| 24 | 14.06 | -236.8 | -187.6 | 8.92 | 6.03 | 10.25 | 1178 | 8.53 | 8162 |
| 25 | 14.28 | -227.1 | -177.1 | 9.35 | 6.10 | 10.74 | 1154 | 8.31 | 7562 |
| 26 | 14.51 | -216.9 | -166.1 | 9.78 | 6.16 | 11.27 | 1130 | 8.07 | 6974 |
| 27 | 14.76 | -206.2 | -154.6 | 10.21 | 6.21 | 11.82 | 1104 | 7.81 | 6400 |
| 28 | 15.04 | -195.1 | -142.4 | 10.65 | 6.26 | 12.42 | 1076 | 7.53 | 5828 |
| 29 | 15.35 | -183.4 | -129.7 | 11.10 | 6.30 | 13.06 | 1047 | 7.23 | 5286 |
| 30 | 15.69 | -171.2 | -116.3 | 11.56 | 6.33 | 13.73 | 1017 | 6.92 | 4774 |
| 31 | 16.07 | -158.4 | -102.2 | 12.02 | 6.36 | 14.51 | 985 | 6.59 | 4258 |
| 32 | 16.49 | -145.0 | -87.3 | 12.49 | 6.40 | 15.39 | 951 | 6.24 | 3763 |
| 33 | 16.97 | -130.8 | -71.4 | 12.98 | 6.43 | 16.38 | 916 | 5.87 | 3295 |
| 34 | 17.52 | -115.8 | -54.4 | 13.49 | 6.46 | 17.53 | 879 | 5.49 | 2847 |
| 35 | 18.16 | -99.9 | -36.3 | 14.01 | 6.50 | 18.81 | 841 | 5.10 | 2442 |
| 36 | 18.91 | -83.0 | -16.8 | 14.56 | 6.54 | 20.25 | 802 | 4.70 | 2077 |
| 37 | 19.79 | -65.0 | 4.3 | 15.14 | 6.58 | 21.84 | 763 | 4.30 | 1756 |
| 38 | 20.84 | -46.0 | 27.0 | 15.74 | 6.63 | 23.57 | 726 | 3.90 | 1481 |
| 39 | 22.09 | -25.9 | 51.4 | 16.38 | 6.68 | 25.32 | 690 | 3.51 | 1257 |
| 40 | 23.56 | -5.1 | 77.4 | 17.04 | 6.73 | 26.65 | 660 | 3.14 | 1099 |
| 42 | 27.17 | 37.3 | 132.4 | 18.38 | 6.82 | 27.90 | 615 | 2.51 | 926 |
| 44 | 31.41 | 77.2 | 187.1 | 19.65 | 6.84 | 26.43 | 595 | 2.04 | 917 |
| 46 | 35.78 | 111.6 | 236.8 | 20.76 | 6.83 | 23.72 | 591 | 1.70 | 1007 |
| 48 | 40.00 | 141.6 | 281.6 | 21.71 | 6.79 | 21.24 | 596 | 1.46 | 1135 |
| 50 | 44.01 | 168.1 | 322.1 | 22.54 | 6.76 | 19.34 | 605 | 1.29 | 1278 |
| 55 | 53.22 | 224.4 | 410.7 | 24.23 | 6.76 | 16.43 | 630 | 1.01 | 1634 |
| 60 | 61.60 | 273.3 | 489.9 | 25.59 | 6.81 | 14.93 | 657 | 0.84 | 1971 |
| 65 | 69.48 | 318.4 | 561.6 | 26.75 | 6.95 | 14.14 | 683 | 0.72 | 2289 |
| 70 | 76.95 | 361.8 | 631.1 | 27.78 | 7.15 | 13.72 | 705 | 0.64 | 2589 |
| 75 | 84.16 | 404.6 | 699.2 | 28.72 | 7.42 | 13.54 | 724 | 0.58 | 2874 |
| 80 | 91.16 | 447.8 | 766.8 | 29.60 | 7.74 | 13.54 | 742 | 0.52 | 3148 |
| 85 | 98.01 | 491.8 | 834.8 | 30.42 | 8.11 | 13.66 | 758 | 0.48 | 3414 |
| 90 | 104.73 | 537.1 | 903.6 | 31.21 | 8.51 | 13.87 | 774 | 0.45 | 3672 |
| 95 | 111.35 | 583.9 | 973.6 | 31.96 | 8.93 | 14.13 | 788 | 0.42 | 3925 |
| 100 | 117.89 | 632.4 | 1045.0 | 32.70 | 9.35 | 14.43 | 802 | 0.39 | 4172 |
| 110 | 130.74 | 735.3 | 1192.9 | 34.10 | 10.20 | 15.07 | 829 | 0.35 | 4652 |
| 120 | 143.40 | 844.6 | 1346.5 | 35.44 | 10.91 | 15.64 | 857 | 0.31 | 5121 |
| 130 | 155.92 | 959.6 | 1505.3 | 36.71 | 11.47 | 16.10 | 885 | 0.29 | 5581 |
| 140 | 168.32 | 1078.9 | 1668.0 | 37.92 | 11.88 | 16.43 | 913 | 0.26 | 6033 |
| 150 | 180.63 | 1201.2 | 1833.4 | 39.06 | 12.14 | 16.62 | 942 | 0.24 | 6480 |
| 160 | 192.87 | 1325.0 | 2000.1 | 40.13 | 12.26 | 16.70 | 971 | 0.23 | 6922 |
| 170 | 205.05 | 1449.3 | 2167.0 | 41.15 | 12.28 | 16.68 | 1000 | 0.21 | 7360 |
| 180 | 217.14 | 1573.3 | 2333.4 | 42.10 | 12.23 | 16.59 | 1028 | 0.20 | 7795 |
| 190 | 229.27 | 1696.2 | 2498.7 | 42.99 | 12.12 | 16.46 | 1057 | 0.19 | 8228 |
| 200 | 241.33 | 1817.8 | 2662.4 | 43.83 | 11.98 | 16.29 | 1085 | 0.18 | 8658 |
| 220 | 265.36 | 2056.0 | 2984.7 | 45.37 | 11.66 | 15.94 | 1140 | 0.16 | 9513 |
| 240 | 289.30 | 2287.5 | 3300.1 | 46.74 | 11.35 | 15.60 | 1193 | 0.15 | 10362 |
| 260 | 313.18 | 2513.1 | 3609.3 | 47.98 | 11.10 | 15.32 | 1244 | 0.14 | 11208 |
| 280 | 337.00 | 2733.9 | 3913.4 | 49.10 | 10.93 | 15.10 | 1292 | 0.13 | 12049 |
| 300 | 360.79 | 2951.0 | 4213.8 | 50.14 | 10.74 | 14.94 | 1339 | 0.12 | 12888 |

* TWO PHASE BOUNDARY

TABLE VI. THERMODYNAMIC PROPERTIES OF PARAHYDROGEN

| | 40 BAR ISOBAR TEMPERATURE K | MOLAR VOLUME CM3/G | INTERNAL ENERGY J/G | ENTHALPY J/G | ENTROPY J/G-K | SPECIFIC HEAT CV J/G-K | SPECIFIC HEAT CP J/G-K | VELOCITY OF SOUND M/S | $\left(\frac{\partial P}{\partial T}\right)_V$ BAR/K | $\left(\frac{\partial P}{\partial \rho}\right)_T$ BAR-CM3/G |
|---|---|---|---|---|---|---|---|---|---|---|
| * | 15.080 | 12.64 | -306.9 | -256.4 | 5.06 | 4.85 | 6.40 | 1364 | 9.52 | 14114 |
| | 16 | 12.74 | -301.3 | -250.3 | 5.45 | 5.03 | 6.78 | 1358 | 9.61 | 13669 |
| | 17 | 12.86 | -294.8 | -243.3 | 5.87 | 5.20 | 7.21 | 1340 | 9.62 | 12952 |
| | 18 | 12.98 | -287.8 | -235.9 | 6.30 | 5.36 | 7.63 | 1322 | 9.57 | 12282 |
| | 19 | 13.12 | -280.6 | -228.1 | 6.72 | 5.50 | 8.01 | 1304 | 9.47 | 11685 |
| | 20 | 13.26 | -272.9 | -219.9 | 7.14 | 5.63 | 8.41 | 1283 | 9.33 | 11022 |
| | 21 | 13.42 | -264.9 | -211.3 | 7.56 | 5.75 | 8.81 | 1263 | 9.18 | 10394 |
| | 22 | 13.58 | -256.6 | -202.3 | 7.98 | 5.85 | 9.21 | 1244 | 9.02 | 9818 |
| | 23 | 13.76 | -247.9 | -192.8 | 8.40 | 5.94 | 9.63 | 1223 | 8.85 | 9228 |
| | 24 | 13.94 | -238.8 | -183.0 | 8.82 | 6.02 | 10.07 | 1202 | 8.66 | 8639 |
| | 25 | 14.15 | -229.3 | -172.7 | 9.24 | 6.09 | 10.53 | 1179 | 8.45 | 8052 |
| | 26 | 14.37 | -219.4 | -161.9 | 9.66 | 6.15 | 11.01 | 1156 | 8.22 | 7468 |
| | 27 | 14.60 | -209.1 | -150.7 | 10.09 | 6.21 | 11.53 | 1130 | 7.98 | 6878 |
| | 28 | 14.86 | -198.3 | -138.9 | 10.51 | 6.26 | 12.06 | 1105 | 7.71 | 6335 |
| | 29 | 15.14 | -187.1 | -126.5 | 10.95 | 6.30 | 12.62 | 1078 | 7.43 | 5805 |
| | 30 | 15.45 | -175.4 | -113.6 | 11.39 | 6.33 | 13.22 | 1051 | 7.13 | 5291 |
| | 31 | 15.79 | -163.2 | -100.1 | 11.83 | 6.37 | 13.89 | 1022 | 6.83 | 4785 |
| | 32 | 16.16 | -150.5 | -85.8 | 12.28 | 6.40 | 14.60 | 992 | 6.50 | 4312 |
| | 33 | 16.58 | -137.1 | -70.8 | 12.74 | 6.43 | 15.43 | 959 | 6.17 | 3834 |
| | 34 | 17.05 | -123.2 | -55.0 | 13.22 | 6.46 | 16.27 | 927 | 5.82 | 3410 |
| | 35 | 17.57 | -108.5 | -38.2 | 13.70 | 6.49 | 17.26 | 893 | 5.47 | 2998 |
| | 36 | 18.18 | -93.2 | -20.5 | 14.20 | 6.52 | 18.32 | 859 | 5.10 | 2623 |
| | 37 | 18.86 | -77.0 | -1.6 | 14.72 | 6.55 | 19.45 | 824 | 4.74 | 2287 |
| | 38 | 19.65 | -60.1 | 18.5 | 15.25 | 6.58 | 20.64 | 791 | 4.37 | 1993 |
| | 39 | 20.56 | -42.5 | 39.7 | 15.81 | 6.61 | 21.84 | 759 | 4.01 | 1742 |
| | 40 | 21.61 | -24.3 | 62.1 | 16.37 | 6.64 | 23.02 | 729 | 3.67 | 1532 |
| | 42 | 24.13 | 13.4 | 110.0 | 17.54 | 6.71 | 24.62 | 680 | 3.04 | 1259 |
| | 44 | 27.19 | 51.0 | 159.8 | 18.70 | 6.77 | 24.96 | 647 | 2.52 | 1135 |
| | 46 | 30.61 | 85.8 | 208.3 | 19.78 | 6.81 | 23.88 | 630 | 2.12 | 1131 |
| | 48 | 34.13 | 117.7 | 254.3 | 20.76 | 6.81 | 22.07 | 625 | 1.81 | 1205 |
| | 50 | 37.60 | 146.3 | 296.7 | 21.62 | 6.79 | 20.33 | 627 | 1.59 | 1314 |
| | 55 | 45.76 | 206.9 | 389.9 | 23.40 | 6.79 | 17.26 | 645 | 1.22 | 1637 |
| | 60 | 53.26 | 258.7 | 471.7 | 24.83 | 6.84 | 15.54 | 668 | 1.00 | 1967 |
| | 65 | 60.27 | 305.7 | 546.8 | 26.03 | 6.97 | 14.59 | 691 | 0.86 | 2283 |
| | 70 | 67.00 | 350.6 | 618.6 | 27.09 | 7.17 | 14.07 | 713 | 0.75 | 2590 |
| | 75 | 73.42 | 394.6 | 688.3 | 28.05 | 7.44 | 13.84 | 732 | 0.68 | 2880 |
| | 80 | 79.65 | 438.7 | 757.3 | 28.94 | 7.76 | 13.78 | 749 | 0.61 | 3160 |
| | 85 | 85.73 | 483.5 | 826.4 | 29.78 | 8.13 | 13.87 | 765 | 0.56 | 3430 |
| | 90 | 91.69 | 529.4 | 896.1 | 30.58 | 8.52 | 14.05 | 780 | 0.52 | 3693 |
| | 95 | 97.55 | 576.7 | 966.9 | 31.35 | 8.94 | 14.29 | 794 | 0.48 | 3949 |
| | 100 | 103.34 | 625.7 | 1039.0 | 32.09 | 9.36 | 14.56 | 808 | 0.45 | 4200 |
| | 110 | 114.68 | 729.5 | 1188.3 | 33.51 | 10.21 | 15.18 | 834 | 0.40 | 4686 |
| | 120 | 125.85 | 839.4 | 1342.8 | 34.85 | 10.92 | 15.73 | 862 | 0.36 | 5160 |
| | 130 | 136.87 | 954.9 | 1502.4 | 36.13 | 11.48 | 16.17 | 890 | 0.33 | 5625 |
| | 140 | 147.79 | 1074.7 | 1665.8 | 37.34 | 11.89 | 16.49 | 918 | 0.30 | 6081 |
| | 150 | 158.61 | 1197.3 | 1831.7 | 38.48 | 12.15 | 16.68 | 947 | 0.28 | 6531 |
| | 160 | 169.37 | 1321.4 | 1998.9 | 39.56 | 12.27 | 16.74 | 976 | 0.26 | 6976 |
| | 170 | 180.06 | 1446.0 | 2166.3 | 40.58 | 12.29 | 16.72 | 1004 | 0.24 | 7417 |
| | 180 | 190.71 | 1570.2 | 2333.1 | 41.53 | 12.24 | 16.63 | 1033 | 0.23 | 7855 |
| | 190 | 201.33 | 1693.4 | 2498.7 | 42.42 | 12.13 | 16.49 | 1062 | 0.22 | 8289 |
| | 200 | 211.90 | 1815.1 | 2662.7 | 43.27 | 11.99 | 16.32 | 1090 | 0.21 | 8721 |
| | 220 | 232.98 | 2053.6 | 2985.5 | 44.81 | 11.67 | 15.96 | 1145 | 0.19 | 9580 |
| | 240 | 253.97 | 2285.4 | 3301.3 | 46.18 | 11.36 | 15.62 | 1198 | 0.17 | 10432 |
| | 260 | 274.89 | 2511.3 | 3610.8 | 47.42 | 11.10 | 15.34 | 1248 | 0.16 | 11280 |
| | 280 | 295.77 | 2732.3 | 3915.3 | 48.55 | 10.90 | 15.12 | 1297 | 0.14 | 12123 |
| | 300 | 316.60 | 2949.5 | 4215.9 | 49.58 | 10.75 | 14.95 | 1343 | 0.13 | 12964 |

* TWO PHASE BOUNDARY

TABLE VI. THERMODYNAMIC PROPERTIES OF PARAHYDROGEN

45 BAR ISOBAR

| | TEMPERATURE K | MOLAR VOLUME CM3/G | INTERNAL ENERGY J/G | ENTHALPY J/G | ENTROPY J/G-K | SPECIFIC HEAT CV J/G-K | SPECIFIC HEAT CP J/G-K | VELOCITY OF SOUND M/S | $\left(\frac{\partial P}{\partial T}\right)_V$ BAR/K | $\left(\frac{\partial P}{\partial \rho}\right)_T$ BAR-CM3/G |
|---|---|---|---|---|---|---|---|---|---|---|
| * | 15.232 | 12.60 | -306.6 | -249.3 | 5.07 | 4.87 | 6.40 | 1377 | 9.56 | 14433 |
| | 16 | 12.68 | -301.9 | -244.9 | 5.19 | 5.02 | 6.72 | 1371 | 9.63 | 14035 |
| | 17 | 12.79 | -295.5 | -237.9 | 5.81 | 5.20 | 7.14 | 1355 | 9.66 | 13368 |
| | 18 | 12.92 | -288.7 | -230.6 | 6.23 | 5.36 | 7.55 | 1338 | 9.64 | 12699 |
| | 19 | 13.05 | -281.6 | -222.8 | 6.65 | 5.50 | 7.94 | 1321 | 9.56 | 12084 |
| | 20 | 13.19 | -274.1 | -214.7 | 7.07 | 5.62 | 8.31 | 1303 | 9.43 | 11496 |
| | 21 | 13.33 | -266.2 | -206.2 | 7.48 | 5.74 | 8.70 | 1283 | 9.29 | 10864 |
| | 22 | 13.49 | -258.0 | -197.3 | 7.90 | 5.84 | 9.10 | 1264 | 9.13 | 10257 |
| | 23 | 13.66 | -249.5 | -188.0 | 8.31 | 5.93 | 9.50 | 1244 | 8.96 | 9671 |
| | 24 | 13.84 | -240.6 | -178.3 | 8.72 | 6.02 | 9.91 | 1224 | 8.78 | 9091 |
| | 25 | 14.03 | -231.3 | -168.2 | 9.14 | 6.09 | 10.34 | 1202 | 8.58 | 8514 |
| | 26 | 14.23 | -221.7 | -157.6 | 9.55 | 6.15 | 10.79 | 1180 | 8.36 | 7937 |
| | 27 | 14.45 | -211.7 | -146.6 | 9.97 | 6.21 | 11.27 | 1157 | 8.13 | 7373 |
| | 28 | 14.69 | -201.2 | -135.1 | 10.39 | 6.26 | 11.76 | 1132 | 7.88 | 6827 |
| | 29 | 14.95 | -190.4 | -123.1 | 10.81 | 6.30 | 12.27 | 1107 | 7.61 | 6302 |
| | 30 | 15.24 | -179.1 | -110.5 | 11.23 | 6.34 | 12.81 | 1082 | 7.33 | 5792 |
| | 31 | 15.54 | -167.4 | -97.5 | 11.66 | 6.37 | 13.38 | 1054 | 7.04 | 5295 |
| | 32 | 15.88 | -155.2 | -83.8 | 12.10 | 6.40 | 14.00 | 1027 | 6.74 | 4825 |
| | 33 | 16.25 | -142.6 | -69.4 | 12.54 | 6.43 | 14.66 | 998 | 6.43 | 4372 |
| | 34 | 16.66 | -129.4 | -54.4 | 12.99 | 6.46 | 15.40 | 968 | 6.10 | 3932 |
| | 35 | 17.11 | -115.7 | -38.6 | 13.44 | 6.48 | 16.21 | 937 | 5.77 | 3515 |
| | 36 | 17.62 | -101.3 | -22.1 | 13.91 | 6.51 | 17.00 | 907 | 5.44 | 3150 |
| | 37 | 18.19 | -86.5 | -4.6 | 14.39 | 6.53 | 17.89 | 876 | 5.10 | 2803 |
| | 38 | 18.83 | -71.0 | 13.7 | 14.88 | 6.56 | 18.81 | 845 | 4.76 | 2491 |
| | 39 | 19.54 | -55.0 | 33.0 | 15.38 | 6.58 | 19.73 | 816 | 4.43 | 2218 |
| | 40 | 20.35 | -38.4 | 53.1 | 15.89 | 6.60 | 20.64 | 788 | 4.10 | 1984 |
| | 42 | 22.26 | -4.2 | 96.0 | 16.93 | 6.65 | 22.14 | 738 | 3.49 | 1636 |
| | 44 | 24.57 | 30.7 | 141.2 | 17.98 | 6.70 | 22.95 | 701 | 2.96 | 1433 |
| | 46 | 27.22 | 64.2 | 186.7 | 18.99 | 6.77 | 22.91 | 675 | 2.52 | 1345 |
| | 48 | 30.08 | 96.4 | 231.8 | 19.95 | 6.80 | 22.06 | 661 | 2.17 | 1345 |
| | 50 | 33.02 | 126.0 | 274.6 | 20.83 | 6.81 | 20.75 | 656 | 1.90 | 1411 |
| | 55 | 40.20 | 189.9 | 370.8 | 22.66 | 6.82 | 17.90 | 663 | 1.45 | 1677 |
| | 60 | 46.93 | 244.3 | 455.5 | 24.14 | 6.87 | 16.06 | 682 | 1.18 | 1989 |
| | 65 | 53.26 | 293.3 | 532.9 | 25.38 | 6.99 | 15.01 | 702 | 1.00 | 2299 |
| | 70 | 59.29 | 339.5 | 606.3 | 26.47 | 7.19 | 14.42 | 722 | 0.87 | 2600 |
| | 75 | 65.09 | 384.7 | 677.6 | 27.45 | 7.46 | 14.12 | 740 | 0.78 | 2893 |
| | 80 | 70.76 | 429.7 | 748.1 | 28.36 | 7.78 | 14.02 | 757 | 0.70 | 3179 |
| | 85 | 76.23 | 475.2 | 818.3 | 29.21 | 8.14 | 14.06 | 772 | 0.64 | 3453 |
| | 90 | 81.59 | 521.8 | 888.9 | 30.02 | 8.54 | 14.21 | 787 | 0.59 | 3719 |
| | 95 | 86.86 | 569.7 | 960.5 | 30.79 | 8.95 | 14.43 | 801 | 0.55 | 3979 |
| | 100 | 92.06 | 619.1 | 1033.3 | 31.54 | 9.37 | 14.69 | 815 | 0.52 | 4234 |
| | 110 | 102.22 | 723.8 | 1183.8 | 32.97 | 10.23 | 15.28 | 840 | 0.46 | 4724 |
| | 120 | 112.22 | 834.3 | 1339.3 | 34.33 | 10.93 | 15.81 | 867 | 0.41 | 5203 |
| | 130 | 122.08 | 950.3 | 1499.6 | 35.61 | 11.49 | 16.25 | 895 | 0.37 | 5671 |
| | 140 | 131.83 | 1070.5 | 1663.7 | 36.82 | 11.90 | 16.55 | 923 | 0.34 | 6131 |
| | 150 | 141.50 | 1193.4 | 1830.2 | 37.97 | 12.15 | 16.73 | 952 | 0.32 | 6585 |
| | 160 | 151.10 | 1317.9 | 1997.8 | 39.06 | 12.28 | 16.79 | 981 | 0.29 | 7032 |
| | 170 | 160.64 | 1442.8 | 2165.6 | 40.07 | 12.30 | 16.76 | 1009 | 0.28 | 7476 |
| | 180 | 170.14 | 1567.2 | 2332.8 | 41.03 | 12.24 | 16.66 | 1038 | 0.26 | 7916 |
| | 190 | 179.60 | 1690.5 | 2498.7 | 41.92 | 12.13 | 16.52 | 1066 | 0.24 | 8352 |
| | 200 | 189.02 | 1812.5 | 2663.1 | 42.77 | 11.99 | 16.35 | 1094 | 0.23 | 8786 |
| | 220 | 207.80 | 2051.3 | 2986.4 | 44.31 | 11.67 | 15.98 | 1149 | 0.21 | 9648 |
| | 240 | 226.49 | 2283.4 | 3302.6 | 45.68 | 11.37 | 15.64 | 1202 | 0.19 | 10503 |
| | 260 | 245.12 | 2509.4 | 3612.5 | 46.93 | 11.11 | 15.36 | 1253 | 0.18 | 11352 |
| | 280 | 263.70 | 2730.6 | 3917.3 | 48.05 | 10.90 | 15.13 | 1301 | 0.16 | 12198 |
| | 300 | 282.24 | 2948.0 | 4218.1 | 49.09 | 10.75 | 14.96 | 1347 | 0.15 | 13040 |

* TWO PHASE BOUNDARY

TABLE VI. THERMODYNAMIC PROPERTIES OF PARAHYDROGEN

| | 50 BAR ISOBAR TEMPERATURE K | MOLAR VOLUME CM3/G | INTERNAL ENERGY J/G | ENTHALPY J/G | ENTROPY J/G-K | SPECIFIC HEAT CV J/G-K | SPECIFIC HEAT CP J/G-K | VELOCITY OF SOUND M/S | $\left(\frac{\partial P}{\partial T}\right)_V$ BAR/K | $\left(\frac{\partial P}{\partial \rho}\right)_T$ BAR-CM3/G |
|---|---|---|---|---|---|---|---|---|---|---|
| * | 15.382 | 12.56 | -306.2 | -243.5 | 5.08 | 4.88 | 6.40 | 1390 | 9.59 | 14748 |
| | 16 | 12.62 | -302.5 | -239.4 | 5.34 | 5.01 | 6.66 | 1384 | 9.66 | 14421 |
| | 17 | 12.73 | -296.2 | -232.6 | 5.75 | 5.19 | 7.07 | 1370 | 9.70 | 13772 |
| | 18 | 12.85 | -289.9 | -225.3 | 6.17 | 5.35 | 7.48 | 1354 | 9.69 | 13109 |
| | 19 | 12.98 | -282.5 | -217.6 | 6.59 | 5.49 | 7.87 | 1337 | 9.62 | 12481 |
| | 20 | 13.11 | -275.1 | -209.5 | 7.00 | 5.62 | 8.23 | 1322 | 9.51 | 11938 |
| | 21 | 13.25 | -267.4 | -201.1 | 7.41 | 5.73 | 8.61 | 1302 | 9.38 | 11293 |
| | 22 | 13.40 | -259.4 | -192.3 | 7.82 | 5.84 | 8.99 | 1284 | 9.23 | 10704 |
| | 23 | 13.56 | -251.0 | -183.2 | 8.23 | 5.93 | 9.37 | 1264 | 9.07 | 10117 |
| | 24 | 13.73 | -242.3 | -173.6 | 8.63 | 6.01 | 9.76 | 1245 | 8.89 | 9543 |
| | 25 | 13.92 | -233.2 | -163.6 | 9.04 | 6.08 | 10.17 | 1225 | 8.70 | 8977 |
| | 26 | 14.11 | -223.8 | -153.2 | 9.45 | 6.15 | 10.59 | 1204 | 8.50 | 8410 |
| | 27 | 14.32 | -214.0 | -142.4 | 9.86 | 6.21 | 11.03 | 1181 | 8.27 | 7853 |
| | 28 | 14.54 | -203.9 | -131.2 | 10.26 | 6.26 | 11.49 | 1158 | 8.04 | 7308 |
| | 29 | 14.78 | -193.4 | -119.4 | 10.68 | 6.31 | 11.97 | 1134 | 7.78 | 6783 |
| | 30 | 15.04 | -182.5 | -107.2 | 11.09 | 6.34 | 12.47 | 1109 | 7.52 | 6263 |
| | 31 | 15.33 | -171.1 | -94.5 | 11.51 | 6.33 | 12.98 | 1084 | 7.24 | 5777 |
| | 32 | 15.63 | -159.4 | -81.3 | 11.93 | 6.41 | 13.51 | 1059 | 6.95 | 5320 |
| | 33 | 15.97 | -147.3 | -67.5 | 12.35 | 6.44 | 14.09 | 1033 | 6.66 | 4874 |
| | 34 | 16.33 | -134.7 | -53.1 | 12.78 | 6.46 | 14.72 | 1005 | 6.36 | 4435 |
| | 35 | 16.73 | -121.7 | -39.0 | 13.22 | 6.49 | 15.36 | 977 | 6.04 | 4034 |
| | 36 | 17.17 | -108.2 | -22.3 | 13.66 | 6.51 | 16.08 | 949 | 5.73 | 3646 |
| | 37 | 17.66 | -94.2 | -5.9 | 14.11 | 6.53 | 16.77 | 921 | 5.41 | 3303 |
| | 38 | 18.20 | -79.8 | 11.2 | 14.57 | 6.55 | 17.51 | 893 | 5.09 | 2981 |
| | 39 | 18.79 | -64.9 | 29.1 | 15.03 | 6.57 | 18.26 | 865 | 4.78 | 2691 |
| | 40 | 19.45 | -49.5 | 47.7 | 15.50 | 6.58 | 18.96 | 839 | 4.47 | 2443 |
| | 42 | 20.99 | -17.9 | 87.1 | 16.46 | 6.62 | 20.28 | 791 | 3.88 | 2041 |
| | 44 | 22.81 | 14.6 | 128.7 | 17.43 | 6.66 | 21.22 | 751 | 3.36 | 1771 |
| | 46 | 24.92 | 46.5 | 171.1 | 18.37 | 6.73 | 21.64 | 720 | 2.90 | 1615 |
| | 48 | 27.25 | 77.9 | 214.2 | 19.29 | 6.78 | 21.39 | 701 | 2.53 | 1555 |
| | 50 | 29.71 | 107.7 | 256.3 | 20.15 | 6.80 | 20.66 | 689 | 2.22 | 1565 |
| | 55 | 35.98 | 173.7 | 353.6 | 22.01 | 6.84 | 18.30 | 685 | 1.68 | 1756 |
| | 60 | 42.03 | 230.4 | 440.5 | 23.52 | 6.89 | 16.50 | 698 | 1.36 | 2035 |
| | 65 | 47.77 | 281.1 | 519.9 | 24.79 | 7.01 | 15.37 | 715 | 1.15 | 2333 |
| | 70 | 53.25 | 328.7 | 595.0 | 25.90 | 7.21 | 14.72 | 733 | 1.00 | 2631 |
| | 75 | 58.54 | 374.9 | 667.6 | 26.91 | 7.47 | 14.38 | 749 | 0.89 | 2919 |
| | 80 | 63.65 | 420.8 | 739.1 | 27.83 | 7.79 | 14.25 | 765 | 0.80 | 3204 |
| | 85 | 68.68 | 467.1 | 810.5 | 28.70 | 8.16 | 14.26 | 780 | 0.73 | 3483 |
| | 90 | 73.56 | 514.3 | 882.1 | 29.51 | 8.55 | 14.38 | 794 | 0.67 | 3752 |
| | 95 | 78.35 | 562.7 | 954.4 | 30.30 | 8.96 | 14.57 | 808 | 0.62 | 4015 |
| | 100 | 83.06 | 612.6 | 1027.9 | 31.05 | 9.38 | 14.82 | 821 | 0.58 | 4272 |
| | 110 | 92.28 | 718.2 | 1179.6 | 32.49 | 10.24 | 15.38 | 846 | 0.51 | 4766 |
| | 120 | 101.34 | 829.3 | 1336.0 | 33.85 | 10.95 | 15.90 | 873 | 0.46 | 5249 |
| | 130 | 110.26 | 945.7 | 1497.1 | 35.14 | 11.51 | 16.31 | 901 | 0.42 | 5721 |
| | 140 | 119.08 | 1066.3 | 1661.7 | 36.36 | 11.91 | 16.61 | 929 | 0.38 | 6184 |
| | 150 | 127.82 | 1189.7 | 1828.8 | 37.52 | 12.16 | 16.78 | 957 | 0.35 | 6640 |
| | 160 | 136.49 | 1314.4 | 1996.9 | 38.60 | 12.28 | 16.83 | 986 | 0.33 | 7091 |
| | 170 | 145.11 | 1439.5 | 2165.1 | 39.62 | 12.31 | 16.80 | 1014 | 0.31 | 7536 |
| | 180 | 153.69 | 1564.2 | 2332.6 | 40.58 | 12.25 | 16.70 | 1043 | 0.29 | 7978 |
| | 190 | 162.22 | 1687.8 | 2498.9 | 41.48 | 12.14 | 16.55 | 1071 | 0.27 | 8417 |
| | 200 | 170.73 | 1809.9 | 2663.5 | 42.32 | 12.00 | 16.38 | 1099 | 0.26 | 8852 |
| | 220 | 187.66 | 2049.0 | 2987.3 | 43.86 | 11.69 | 16.01 | 1154 | 0.23 | 9717 |
| | 240 | 204.51 | 2281.3 | 3303.9 | 45.24 | 11.37 | 15.66 | 1207 | 0.21 | 10574 |
| | 260 | 221.30 | 2507.6 | 3614.1 | 46.48 | 11.11 | 15.37 | 1257 | 0.20 | 11426 |
| | 280 | 238.05 | 2729.0 | 3919.2 | 47.61 | 10.91 | 15.15 | 1305 | 0.18 | 12273 |
| | 300 | 254.75 | 2946.5 | 4220.3 | 48.65 | 10.75 | 14.97 | 1351 | 0.17 | 13116 |

* TWO PHASE BOUNDARY

TABLE VI. THERMODYNAMIC PROPERTIES OF PARAHYDROGEN

| 60 BAR ISOBAR TEMPERATURE K | MOLAR VOLUME $CM^3/G$ | INTERNAL ENERGY J/G | ENTHALPY J/G | ENTROPY J/G-K | SPECIFIC HEAT CV J/G-K | SPECIFIC HEAT CP J/G-K | VELOCITY OF SOUND M/S | $\left(\frac{\partial P}{\partial T}\right)_V$ BAR/K | $\left(\frac{\partial P}{\partial \rho}\right)_T$ BAR-$CM^3/G$ |
|---|---|---|---|---|---|---|---|---|---|
| * 15.678 | 12.48 | -305.5 | -230.6 | 5.10 | 4.92 | 6.41 | 1414 | 9.66 | 15354 |
| 16 | 12.52 | -303.6 | -228.5 | 5.24 | 4.98 | 6.54 | 1411 | 9.70 | 15186 |
| 17 | 12.62 | -297.5 | -221.8 | 5.64 | 5.17 | 6.95 | 1397 | 9.77 | 14523 |
| 18 | 12.73 | -291.0 | -214.6 | 6.05 | 5.34 | 7.35 | 1383 | 9.78 | 13893 |
| 19 | 12.85 | -284.2 | -207.1 | 6.46 | 5.48 | 7.73 | 1368 | 9.75 | 13277 |
| 20 | 12.97 | -277.0 | -199.2 | 6.87 | 5.61 | 8.09 | 1352 | 9.66 | 12679 |
| 21 | 13.11 | -269.5 | -190.9 | 7.27 | 5.72 | 8.43 | 1339 | 9.55 | 12173 |
| 22 | 13.24 | -261.8 | -182.3 | 7.67 | 5.83 | 8.79 | 1320 | 9.42 | 11549 |
| 23 | 13.39 | -253.7 | -173.3 | 8.07 | 5.92 | 9.15 | 1302 | 9.27 | 10976 |
| 24 | 13.55 | -245.3 | -164.0 | 8.47 | 6.01 | 9.52 | 1284 | 9.11 | 10405 |
| 25 | 13.71 | -236.6 | -154.3 | 8.86 | 6.08 | 9.89 | 1265 | 8.93 | 9848 |
| 26 | 13.89 | -227.5 | -144.2 | 9.26 | 6.15 | 10.27 | 1246 | 8.74 | 9302 |
| 27 | 14.08 | -218.2 | -133.8 | 9.65 | 6.21 | 10.66 | 1226 | 8.54 | 8758 |
| 28 | 14.27 | -208.5 | -122.9 | 10.05 | 6.27 | 11.07 | 1205 | 8.32 | 8224 |
| 29 | 14.49 | -198.5 | -111.6 | 10.44 | 6.31 | 11.48 | 1183 | 8.09 | 7703 |
| 30 | 14.72 | -188.2 | -99.9 | 10.84 | 6.35 | 11.90 | 1161 | 7.84 | 7202 |
| 31 | 14.96 | -177.6 | -87.8 | 11.24 | 6.39 | 12.33 | 1139 | 7.59 | 6723 |
| 32 | 15.22 | -166.6 | -75.2 | 11.63 | 6.43 | 12.78 | 1116 | 7.32 | 6260 |
| 33 | 15.50 | -155.3 | -62.2 | 12.03 | 6.45 | 13.26 | 1092 | 7.05 | 5803 |
| 34 | 15.81 | -143.6 | -48.8 | 12.44 | 6.48 | 13.73 | 1068 | 6.78 | 5386 |
| 35 | 16.13 | -131.6 | -34.8 | 12.84 | 6.50 | 14.22 | 1045 | 6.50 | 4991 |
| 36 | 16.49 | -119.2 | -20.3 | 13.25 | 6.52 | 14.74 | 1020 | 6.22 | 4610 |
| 37 | 16.87 | -106.5 | -5.3 | 13.66 | 6.54 | 15.28 | 996 | 5.94 | 4245 |
| 38 | 17.28 | -93.4 | 10.3 | 14.08 | 6.56 | 15.31 | 972 | 5.65 | 3915 |
| 39 | 17.73 | -80.0 | 26.3 | 14.49 | 6.57 | 16.36 | 947 | 5.36 | 3604 |
| 40 | 18.22 | -66.4 | 42.9 | 14.91 | 6.58 | 16.86 | 924 | 5.08 | 3333 |
| 42 | 19.31 | -38.2 | 77.7 | 15.76 | 6.60 | 17.86 | 880 | 4.54 | 2862 |
| 44 | 20.59 | -9.2 | 114.3 | 16.61 | 6.63 | 18.71 | 841 | 4.03 | 2505 |
| 46 | 22.04 | 19.6 | 151.9 | 17.45 | 6.70 | 19.33 | 806 | 3.57 | 2252 |
| 48 | 23.66 | 48.9 | 190.9 | 18.28 | 6.75 | 19.65 | 779 | 3.16 | 2086 |
| 50 | 25.42 | 77.7 | 230.2 | 19.08 | 6.79 | 19.60 | 760 | 2.82 | 2003 |
| 55 | 30.18 | 144.7 | 325.9 | 20.90 | 6.87 | 18.48 | 737 | 2.16 | 2019 |
| 60 | 35.06 | 204.4 | 414.7 | 22.45 | 6.93 | 17.01 | 737 | 1.74 | 2211 |
| 65 | 39.81 | 257.9 | 496.8 | 23.77 | 7.05 | 15.92 | 745 | 1.46 | 2461 |
| 70 | 44.42 | 307.9 | 574.5 | 24.92 | 7.24 | 15.21 | 758 | 1.26 | 2737 |
| 75 | 48.88 | 356.1 | 649.4 | 25.95 | 7.50 | 14.81 | 771 | 1.11 | 3015 |
| 80 | 53.21 | 403.6 | 722.9 | 26.90 | 7.82 | 14.63 | 785 | 0.99 | 3292 |
| 85 | 57.44 | 451.2 | 795.9 | 27.79 | 8.18 | 14.60 | 798 | 0.90 | 3565 |
| 90 | 61.57 | 499.6 | 869.0 | 28.62 | 8.57 | 14.69 | 810 | 0.83 | 3835 |
| 95 | 65.63 | 549.0 | 942.8 | 29.42 | 8.98 | 14.85 | 823 | 0.77 | 4099 |
| 100 | 69.66 | 599.8 | 1017.8 | 30.19 | 9.40 | 15.05 | 836 | 0.71 | 4362 |
| 110 | 77.43 | 707.2 | 1171.8 | 31.66 | 10.27 | 15.58 | 859 | 0.63 | 4862 |
| 120 | 85.07 | 819.4 | 1329.9 | 33.03 | 10.97 | 16.05 | 885 | 0.56 | 5351 |
| 130 | 92.58 | 936.9 | 1492.4 | 34.33 | 11.53 | 16.45 | 912 | 0.51 | 5829 |
| 140 | 100.00 | 1058.2 | 1658.2 | 35.56 | 11.93 | 16.72 | 939 | 0.46 | 6297 |
| 150 | 107.34 | 1182.2 | 1826.3 | 36.72 | 12.19 | 16.88 | 968 | 0.43 | 6758 |
| 160 | 114.62 | 1307.6 | 1995.3 | 37.81 | 12.30 | 16.92 | 996 | 0.40 | 7212 |
| 170 | 121.84 | 1433.2 | 2164.3 | 38.84 | 12.32 | 16.87 | 1024 | 0.37 | 7662 |
| 180 | 129.03 | 1558.3 | 2332.5 | 39.80 | 12.25 | 16.76 | 1053 | 0.35 | 8107 |
| 190 | 136.18 | 1682.3 | 2499.4 | 40.70 | 12.15 | 16.61 | 1081 | 0.33 | 8549 |
| 200 | 143.30 | 1804.7 | 2664.5 | 41.55 | 12.01 | 16.43 | 1109 | 0.31 | 8988 |
| 220 | 157.47 | 2044.5 | 2989.3 | 43.09 | 11.69 | 16.05 | 1163 | 0.28 | 9857 |
| 240 | 171.56 | 2277.3 | 3306.7 | 44.47 | 11.38 | 15.70 | 1216 | 0.26 | 10719 |
| 260 | 185.59 | 2504.0 | 3617.6 | 45.72 | 11.12 | 15.40 | 1266 | 0.24 | 11574 |
| 280 | 199.57 | 2725.8 | 3923.2 | 46.85 | 10.91 | 15.17 | 1314 | 0.22 | 12424 |
| 300 | 213.52 | 2943.7 | 4224.8 | 47.89 | 10.76 | 15.00 | 1360 | 0.20 | 13271 |

* TWO PHASE BOUNDARY

TABLE VI. THERMODYNAMIC PROPERTIES OF PARAHYDROGEN

70 BAR ISOBAR

| | TEMPERATURE K | MOLAR VOLUME CM3/G | INTERNAL ENERGY J/G | ENTHALPY J/G | ENTROPY J/G-K | SPECIFIC HEAT CV J/G-K | SPECIFIC HEAT CP J/G-K | VELOCITY OF SOUND M/S | $\left(\frac{\partial P}{\partial T}\right)_V$ BAR/K | $\left(\frac{\partial P}{\partial \rho}\right)_T$ BAR-CM3/G |
|---|---|---|---|---|---|---|---|---|---|---|
| * | 15.968 | 12.41 | -304.7 | -217.8 | 5.13 | 4.95 | 6.42 | 1437 | 9.74 | 15926 |
| | 16 | 12.42 | -304.5 | -217.6 | 5.14 | 4.96 | 6.43 | 1437 | 9.75 | 15912 |
| | 17 | 12.51 | -298.6 | -211.9 | 5.54 | 5.15 | 6.84 | 1424 | 9.84 | 15284 |
| | 18 | 12.62 | -292.3 | -206.9 | 5.94 | 5.32 | 7.23 | 1410 | 9.87 | 14643 |
| | 19 | 12.73 | -285.6 | -196.5 | 6.34 | 5.47 | 7.60 | 1396 | 9.85 | 14029 |
| | 20 | 12.84 | -278.7 | -188.7 | 6.74 | 5.60 | 7.95 | 1382 | 9.79 | 13451 |
| | 21 | 12.97 | -271.4 | -180.6 | 7.14 | 5.72 | 8.30 | 1367 | 9.70 | 12876 |
| | 22 | 13.10 | -263.8 | -172.1 | 7.53 | 5.82 | 8.62 | 1354 | 9.58 | 12397 |
| | 23 | 13.23 | -256.0 | -163.4 | 7.92 | 5.92 | 8.97 | 1337 | 9.45 | 11795 |
| | 24 | 13.38 | -247.9 | -154.2 | 8.31 | 6.00 | 9.30 | 1320 | 9.30 | 11241 |
| | 25 | 13.53 | -239.5 | -144.7 | 8.70 | 6.08 | 9.65 | 1303 | 9.13 | 10685 |
| | 26 | 13.69 | -230.8 | -134.9 | 9.08 | 6.15 | 10.00 | 1285 | 8.96 | 10144 |
| | 27 | 13.86 | -221.8 | -124.7 | 9.47 | 6.21 | 10.36 | 1267 | 8.77 | 9619 |
| | 28 | 14.04 | -212.5 | -114.2 | 9.85 | 6.27 | 10.73 | 1247 | 8.57 | 9095 |
| | 29 | 14.23 | -202.9 | -103.3 | 10.23 | 6.32 | 11.10 | 1228 | 8.35 | 8585 |
| | 30 | 14.44 | -193.1 | -92.0 | 10.62 | 6.36 | 11.47 | 1207 | 8.13 | 8084 |
| | 31 | 14.65 | -182.9 | -80.4 | 11.00 | 6.40 | 11.86 | 1187 | 7.89 | 7605 |
| | 32 | 14.88 | -172.5 | -68.3 | 11.38 | 6.44 | 12.24 | 1166 | 7.65 | 7148 |
| | 33 | 15.13 | -161.8 | -55.9 | 11.76 | 6.47 | 12.63 | 1144 | 7.40 | 6709 |
| | 34 | 15.39 | -150.8 | -43.0 | 12.15 | 6.50 | 13.03 | 1123 | 7.14 | 6288 |
| | 35 | 15.67 | -139.5 | -29.8 | 12.53 | 6.52 | 13.45 | 1101 | 6.89 | 5886 |
| | 36 | 15.96 | -127.9 | -16.1 | 12.92 | 6.54 | 13.86 | 1080 | 6.63 | 5507 |
| | 37 | 16.28 | -116.0 | -2.1 | 13.30 | 6.56 | 14.31 | 1058 | 6.37 | 5135 |
| | 38 | 16.62 | -103.9 | 12.5 | 13.69 | 6.58 | 14.73 | 1037 | 6.10 | 4800 |
| | 39 | 16.98 | -91.5 | 27.4 | 14.08 | 6.59 | 15.14 | 1015 | 5.84 | 4486 |
| | 40 | 17.37 | -78.9 | 42.7 | 14.46 | 6.59 | 15.55 | 995 | 5.58 | 4195 |
| | 42 | 18.23 | -53.0 | 74.7 | 15.24 | 6.61 | 16.35 | 954 | 5.07 | 3681 |
| | 44 | 19.21 | -26.4 | 108.1 | 16.02 | 6.63 | 17.07 | 916 | 4.58 | 3262 |
| | 46 | 20.30 | 0.2 | 142.3 | 16.78 | 6.70 | 17.71 | 881 | 4.13 | 2936 |
| | 48 | 21.52 | 27.5 | 178.2 | 17.54 | 6.74 | 18.11 | 853 | 3.72 | 2706 |
| | 50 | 22.85 | 54.8 | 214.7 | 18.29 | 6.79 | 18.35 | 829 | 3.36 | 2545 |
| | 55 | 26.53 | 120.5 | 306.2 | 20.03 | 6.88 | 18.09 | 793 | 2.63 | 2394 |
| | 60 | 30.48 | 181.3 | 394.7 | 21.57 | 6.96 | 17.12 | 781 | 2.13 | 2481 |
| | 65 | 34.45 | 236.7 | 477.8 | 22.91 | 7.08 | 16.21 | 781 | 1.78 | 2667 |
| | 70 | 38.36 | 288.5 | 557.1 | 24.08 | 7.27 | 15.54 | 788 | 1.53 | 2902 |
| | 75 | 42.19 | 338.3 | 633.6 | 25.14 | 7.53 | 15.13 | 797 | 1.34 | 3157 |
| | 80 | 45.92 | 387.2 | 708.7 | 26.11 | 7.84 | 14.93 | 807 | 1.20 | 3421 |
| | 85 | 49.57 | 436.1 | 783.1 | 27.01 | 8.20 | 14.87 | 817 | 1.08 | 3687 |
| | 90 | 53.16 | 485.5 | 857.6 | 27.86 | 8.60 | 14.94 | 828 | 0.99 | 3950 |
| | 95 | 56.67 | 535.8 | 932.6 | 28.67 | 9.01 | 15.08 | 840 | 0.92 | 4212 |
| | 100 | 60.14 | 587.4 | 1008.4 | 29.45 | 9.42 | 15.27 | 851 | 0.85 | 4470 |
| | 110 | 66.90 | 696.5 | 1164.7 | 30.94 | 10.30 | 15.81 | 873 | 0.75 | 4972 |
| | 120 | 73.51 | 809.9 | 1324.4 | 32.33 | 11.00 | 16.20 | 897 | 0.66 | 5465 |
| | 130 | 80.00 | 928.3 | 1488.3 | 33.64 | 11.55 | 16.57 | 924 | 0.60 | 5946 |
| | 140 | 86.41 | 1050.4 | 1655.2 | 34.88 | 11.95 | 16.83 | 951 | 0.55 | 6418 |
| | 150 | 92.74 | 1175.1 | 1824.2 | 36.04 | 12.20 | 16.97 | 978 | 0.50 | 6883 |
| | 160 | 99.02 | 1301.0 | 1994.1 | 37.14 | 12.32 | 17.00 | 1006 | 0.47 | 7341 |
| | 170 | 105.25 | 1427.1 | 2163.8 | 38.17 | 12.33 | 16.94 | 1035 | 0.44 | 7794 |
| | 180 | 111.44 | 1552.6 | 2332.7 | 39.13 | 12.27 | 16.83 | 1063 | 0.41 | 8242 |
| | 190 | 117.60 | 1676.9 | 2500.1 | 40.04 | 12.16 | 16.67 | 1091 | 0.39 | 8686 |
| | 200 | 123.72 | 1799.8 | 2665.8 | 40.89 | 12.02 | 16.48 | 1119 | 0.36 | 9127 |
| | 220 | 135.91 | 2040.1 | 2991.5 | 42.44 | 11.70 | 16.09 | 1173 | 0.33 | 10001 |
| | 240 | 148.03 | 2273.4 | 3309.6 | 43.82 | 11.39 | 15.73 | 1225 | 0.30 | 10867 |
| | 260 | 160.09 | 2500.5 | 3621.1 | 45.07 | 11.13 | 15.43 | 1275 | 0.28 | 11725 |
| | 280 | 172.10 | 2722.6 | 3927.3 | 46.21 | 10.92 | 15.20 | 1323 | 0.25 | 12578 |
| | 300 | 184.08 | 2940.8 | 4229.4 | 47.25 | 10.77 | 15.02 | 1369 | 0.24 | 13427 |

* TWO PHASE BOUNDARY

TABLE VI. THERMODYNAMIC PROPERTIES OF PARAHYDROGEN

| | 80 BAR ISOBAR TEMPERATURE K | MOLAR VOLUME $CM^3/G$ | INTERNAL ENERGY J/G | ENTHALPY J/G | ENTROPY J/G-K | SPECIFIC HEAT CV J/G-K | SPECIFIC HEAT CP J/G-K | VELOCITY OF SOUND M/S | $\left(\frac{\partial P}{\partial T}\right)_V$ BAR/K | $\left(\frac{\partial P}{\partial \rho}\right)_T$ BAR-$CM^3/G$ |
|---|---|---|---|---|---|---|---|---|---|---|
| * | 16.253 | 12.34 | -303.9 | -205.1 | 5.14 | 4.99 | 6.53 | 1463 | 10.08 | 16384 |
| | 17 | 12.41 | -299.5 | -200.2 | 5.44 | 5.13 | 6.73 | 1450 | 9.90 | 16011 |
| | 18 | 12.51 | -293.3 | -193.2 | 5.84 | 5.30 | 7.11 | 1437 | 9.95 | 15402 |
| | 19 | 12.62 | -286.9 | -185.9 | 6.23 | 5.46 | 7.48 | 1424 | 9.95 | 14782 |
| | 20 | 12.73 | -280.1 | -179.3 | 6.62 | 5.59 | 7.83 | 1409 | 9.90 | 14177 |
| | 21 | 12.84 | -273.0 | -170.3 | 7.01 | 5.71 | 8.17 | 1396 | 9.83 | 13628 |
| | 22 | 12.97 | -265.7 | -162.0 | 7.40 | 5.82 | 8.49 | 1382 | 9.73 | 13075 |
| | 23 | 13.09 | -258.1 | -153.3 | 7.79 | 5.91 | 8.79 | 1370 | 9.60 | 12613 |
| | 24 | 13.23 | -250.2 | -144.3 | 8.17 | 6.00 | 9.12 | 1354 | 9.47 | 12049 |
| | 25 | 13.37 | -242.0 | -135.1 | 8.55 | 6.07 | 9.45 | 1337 | 9.32 | 11499 |
| | 26 | 13.52 | -233.6 | -125.4 | 8.92 | 6.15 | 9.78 | 1320 | 9.15 | 10958 |
| | 27 | 13.67 | -224.9 | -115.5 | 9.30 | 6.21 | 10.11 | 1303 | 8.98 | 10435 |
| | 28 | 13.84 | -215.9 | -105.2 | 9.67 | 6.27 | 10.45 | 1286 | 8.79 | 9929 |
| | 29 | 14.01 | -206.7 | -94.6 | 10.05 | 6.33 | 10.79 | 1268 | 8.59 | 9424 |
| | 30 | 14.20 | -197.2 | -83.7 | 10.42 | 6.37 | 11.13 | 1249 | 8.38 | 8936 |
| | 31 | 14.39 | -187.5 | -72.4 | 10.79 | 6.41 | 11.48 | 1230 | 8.17 | 8454 |
| | 32 | 14.60 | -177.5 | -60.7 | 11.16 | 6.45 | 11.83 | 1210 | 7.94 | 7994 |
| | 33 | 14.81 | -167.2 | -48.7 | 11.53 | 6.49 | 12.17 | 1191 | 7.70 | 7556 |
| | 34 | 15.04 | -156.7 | -36.4 | 11.89 | 6.51 | 12.52 | 1171 | 7.46 | 7135 |
| | 35 | 15.29 | -146.0 | -23.7 | 12.26 | 6.54 | 12.88 | 1151 | 7.22 | 6735 |
| | 36 | 15.54 | -135.0 | -10.7 | 12.63 | 6.55 | 13.24 | 1131 | 6.98 | 6345 |
| | 37 | 15.82 | -123.8 | 2.8 | 13.00 | 6.53 | 13.60 | 1112 | 6.73 | 5987 |
| | 38 | 16.11 | -112.3 | 16.5 | 13.36 | 6.60 | 13.95 | 1092 | 6.49 | 5645 |
| | 39 | 16.41 | -100.7 | 30.7 | 13.73 | 6.61 | 14.30 | 1073 | 6.24 | 5326 |
| | 40 | 16.74 | -88.8 | 45.1 | 14.10 | 6.62 | 14.64 | 1054 | 6.00 | 5024 |
| | 42 | 17.45 | -64.5 | 75.1 | 14.83 | 6.63 | 15.33 | 1017 | 5.52 | 4475 |
| | 44 | 18.24 | -39.6 | 106.4 | 15.56 | 6.65 | 15.93 | 982 | 5.05 | 4027 |
| | 46 | 19.12 | -14.7 | 138.3 | 16.27 | 6.71 | 16.52 | 947 | 4.61 | 3647 |
| | 48 | 20.09 | 11.1 | 171.8 | 16.98 | 6.75 | 16.95 | 918 | 4.21 | 3360 |
| | 50 | 21.14 | 36.9 | 206.0 | 17.68 | 6.80 | 17.29 | 893 | 3.84 | 3135 |
| | 55 | 24.08 | 100.5 | 293.2 | 19.34 | 6.90 | 17.47 | 849 | 3.07 | 2847 |
| | 60 | 27.33 | 161.2 | 379.8 | 20.85 | 6.99 | 16.98 | 828 | 2.51 | 2819 |
| | 65 | 30.68 | 217.5 | 463.0 | 22.18 | 7.11 | 16.28 | 821 | 2.10 | 2941 |
| | 70 | 34.03 | 270.6 | 542.9 | 23.36 | 7.30 | 15.71 | 821 | 1.80 | 3128 |
| | 75 | 37.34 | 321.7 | 620.4 | 24.43 | 7.55 | 15.35 | 825 | 1.58 | 3349 |
| | 80 | 40.60 | 371.8 | 696.6 | 25.42 | 7.87 | 15.15 | 831 | 1.41 | 3590 |
| | 85 | 43.80 | 421.7 | 772.1 | 26.33 | 8.23 | 15.09 | 839 | 1.27 | 3841 |
| | 90 | 46.95 | 472.0 | 847.6 | 27.19 | 8.62 | 15.14 | 848 | 1.16 | 4096 |
| | 95 | 50.05 | 523.2 | 923.6 | 28.02 | 9.03 | 15.27 | 858 | 1.07 | 4349 |
| | 100 | 53.10 | 575.5 | 1000.3 | 28.80 | 9.44 | 15.45 | 868 | 0.99 | 4605 |
| | 110 | 59.09 | 685.9 | 1158.6 | 30.31 | 10.32 | 15.96 | 889 | 0.87 | 5108 |
| | 120 | 64.95 | 800.6 | 1320.2 | 31.72 | 11.02 | 16.39 | 913 | 0.77 | 5605 |
| | 130 | 70.60 | 919.9 | 1484.7 | 33.03 | 11.57 | 16.69 | 936 | 0.69 | 6073 |
| | 140 | 76.24 | 1042.8 | 1652.7 | 34.28 | 11.97 | 16.93 | 962 | 0.63 | 6548 |
| | 150 | 81.82 | 1168.1 | 1822.6 | 35.45 | 12.21 | 17.05 | 990 | 0.58 | 7015 |
| | 160 | 87.34 | 1294.5 | 1993.3 | 36.55 | 12.33 | 17.07 | 1017 | 0.54 | 7476 |
| | 170 | 92.82 | 1421.1 | 2163.7 | 37.59 | 12.35 | 17.01 | 1045 | 0.50 | 7931 |
| | 180 | 98.26 | 1547.0 | 2333.1 | 38.55 | 12.29 | 16.88 | 1073 | 0.47 | 8381 |
| | 190 | 103.67 | 1671.8 | 2501.1 | 39.46 | 12.18 | 16.72 | 1101 | 0.44 | 8828 |
| | 200 | 109.06 | 1794.9 | 2667.3 | 40.31 | 12.03 | 16.53 | 1128 | 0.42 | 9271 |
| | 220 | 119.76 | 2035.8 | 2993.9 | 41.87 | 11.71 | 16.13 | 1182 | 0.38 | 10149 |
| | 240 | 130.39 | 2269.6 | 3312.7 | 43.26 | 11.40 | 15.77 | 1234 | 0.34 | 11017 |
| | 260 | 140.96 | 2497.1 | 3624.8 | 44.51 | 11.14 | 15.46 | 1284 | 0.32 | 11878 |
| | 280 | 151.50 | 2719.6 | 3931.5 | 45.64 | 10.93 | 15.22 | 1332 | 0.29 | 12734 |
| | 300 | 162.00 | 2938.1 | 4234.0 | 46.69 | 10.77 | 15.04 | 1377 | 0.27 | 13585 |

* TWO PHASE BOUNDARY

TABLE VI. THERMODYNAMIC PROPERTIES OF PARAHYDROGEN

| | 90 BAR ISOBAR TEMPERATURE K | MOLAR VOLUME CM3/G | INTERNAL ENERGY J/G | ENTHALPY J/G | ENTROPY J/G-K | SPECIFIC HEAT CV J/G-K | SPECIFIC HEAT CP J/G-K | VELOCITY OF SOUND M/S | $\left(\frac{\partial P}{\partial T}\right)_V$ BAR/K | $\left(\frac{\partial P}{\partial \rho}\right)_T$ BAR-CM3/G |
|---|---|---|---|---|---|---|---|---|---|---|
| * | 16.532 | 12.28 | -303.0 | -192.5 | 5.16 | 5.04 | 6.55 | 1484 | 10.15 | 16922 |
| | 17 | 12.32 | -300.3 | -189.4 | 5.35 | 5.12 | 6.71 | 1477 | 10.13 | 16654 |
| | 18 | 12.41 | -294.3 | -182.5 | 5.74 | 5.28 | 7.01 | 1463 | 10.02 | 16123 |
| | 19 | 12.51 | -288.0 | -175.4 | 6.13 | 5.44 | 7.37 | 1451 | 10.04 | 15535 |
| | 20 | 12.62 | -281.4 | -167.8 | 6.51 | 5.58 | 7.72 | 1437 | 10.01 | 14931 |
| | 21 | 12.73 | -274.5 | -159.9 | 6.90 | 5.70 | 8.05 | 1423 | 9.95 | 14336 |
| | 22 | 12.84 | -267.3 | -151.7 | 7.28 | 5.81 | 8.36 | 1410 | 9.86 | 13812 |
| | 23 | 12.96 | -259.9 | -143.2 | 7.66 | 5.91 | 8.67 | 1396 | 9.75 | 13277 |
| | 24 | 13.09 | -252.2 | -134.4 | 8.04 | 5.99 | 8.96 | 1385 | 9.62 | 12825 |
| | 25 | 13.22 | -244.2 | -125.2 | 8.41 | 6.07 | 9.27 | 1369 | 9.48 | 12284 |
| | 26 | 13.36 | -236.1 | -115.8 | 8.78 | 6.14 | 9.58 | 1354 | 9.33 | 11752 |
| | 27 | 13.50 | -227.6 | -106.1 | 9.14 | 6.21 | 9.90 | 1337 | 9.17 | 11229 |
| | 28 | 13.66 | -218.9 | -96.0 | 9.51 | 6.28 | 10.21 | 1321 | 8.99 | 10721 |
| | 29 | 13.82 | -210.0 | -85.7 | 9.87 | 6.33 | 10.53 | 1304 | 8.81 | 10234 |
| | 30 | 13.98 | -200.9 | -75.0 | 10.24 | 6.38 | 10.85 | 1287 | 8.61 | 9745 |
| | 31 | 14.16 | -191.4 | -64.0 | 10.60 | 6.42 | 11.16 | 1270 | 8.41 | 9291 |
| | 32 | 14.35 | -181.8 | -52.7 | 10.96 | 6.46 | 11.47 | 1252 | 8.20 | 8839 |
| | 33 | 14.54 | -171.9 | -41.0 | 11.31 | 6.50 | 11.79 | 1234 | 7.98 | 8398 |
| | 34 | 14.75 | -161.8 | -29.1 | 11.67 | 6.53 | 12.10 | 1216 | 7.75 | 7976 |
| | 35 | 14.97 | -151.5 | -16.8 | 12.03 | 6.56 | 12.42 | 1197 | 7.52 | 7573 |
| | 36 | 15.20 | -141.0 | -4.3 | 12.38 | 6.58 | 12.73 | 1179 | 7.29 | 7186 |
| | 37 | 15.44 | -130.3 | 8.6 | 12.73 | 6.61 | 13.05 | 1160 | 7.06 | 6816 |
| | 38 | 15.69 | -119.4 | 21.8 | 13.09 | 6.62 | 13.37 | 1142 | 6.83 | 6460 |
| | 39 | 15.96 | -108.2 | 35.4 | 13.44 | 6.63 | 13.67 | 1124 | 6.59 | 6132 |
| | 40 | 16.24 | -96.9 | 49.2 | 13.79 | 6.64 | 13.98 | 1107 | 6.36 | 5822 |
| | 42 | 16.84 | -73.9 | 77.7 | 14.48 | 6.66 | 14.58 | 1072 | 5.90 | 5246 |
| | 44 | 17.51 | -50.2 | 107.4 | 15.17 | 6.69 | 15.10 | 1039 | 5.46 | 4773 |
| | 46 | 18.25 | -26.6 | 137.6 | 15.85 | 6.74 | 15.62 | 1006 | 5.03 | 4369 |
| | 48 | 19.05 | -2.1 | 169.3 | 16.52 | 6.78 | 16.05 | 977 | 4.63 | 4034 |
| | 50 | 19.92 | 22.5 | 201.8 | 17.18 | 6.82 | 16.41 | 951 | 4.26 | 3760 |
| | 55 | 22.34 | 84.0 | 285.1 | 18.77 | 6.93 | 16.82 | 902 | 3.48 | 3353 |
| | 60 | 25.05 | 143.8 | 369.3 | 20.24 | 7.01 | 16.69 | 874 | 2.87 | 3212 |
| | 65 | 27.91 | 200.5 | 451.7 | 21.55 | 7.14 | 16.23 | 861 | 2.42 | 3258 |
| | 70 | 30.81 | 254.4 | 531.7 | 22.74 | 7.33 | 15.77 | 855 | 2.08 | 3400 |
| | 75 | 33.71 | 306.3 | 609.7 | 23.82 | 7.58 | 15.46 | 855 | 1.82 | 3585 |
| | 80 | 36.58 | 357.3 | 686.5 | 24.81 | 7.89 | 15.29 | 858 | 1.62 | 3799 |
| | 85 | 39.41 | 408.1 | 762.8 | 25.73 | 8.25 | 15.25 | 863 | 1.46 | 4029 |
| | 90 | 42.21 | 459.2 | 839.1 | 26.61 | 8.64 | 15.30 | 869 | 1.33 | 4268 |
| | 95 | 44.97 | 511.1 | 915.8 | 27.44 | 9.04 | 15.42 | 877 | 1.22 | 4516 |
| | 100 | 47.69 | 564.1 | 993.4 | 28.23 | 9.46 | 15.59 | 886 | 1.13 | 4761 |
| | 110 | 53.04 | 675.7 | 1153.0 | 29.75 | 10.34 | 16.09 | 905 | 0.99 | 5258 |
| | 120 | 58.28 | 791.4 | 1315.9 | 31.17 | 11.04 | 16.50 | 927 | 0.88 | 5750 |
| | 130 | 63.42 | 911.7 | 1482.5 | 32.50 | 11.53 | 16.84 | 952 | 0.79 | 6233 |
| | 140 | 68.36 | 1035.4 | 1650.7 | 33.75 | 11.99 | 17.06 | 975 | 0.72 | 6685 |
| | 150 | 73.35 | 1161.3 | 1821.4 | 34.93 | 12.23 | 17.13 | 1001 | 0.66 | 7153 |
| | 160 | 78.23 | 1288.3 | 1992.8 | 36.03 | 12.35 | 17.14 | 1028 | 0.61 | 7616 |
| | 170 | 83.17 | 1415.3 | 2163.8 | 37.07 | 12.36 | 17.07 | 1056 | 0.57 | 8073 |
| | 180 | 88.03 | 1541.6 | 2333.9 | 38.04 | 12.30 | 16.94 | 1084 | 0.53 | 8525 |
| | 190 | 92.86 | 1666.7 | 2502.4 | 38.95 | 12.19 | 16.77 | 1111 | 0.50 | 8974 |
| | 200 | 97.66 | 1790.2 | 2669.1 | 39.81 | 12.04 | 16.58 | 1138 | 0.47 | 9418 |
| | 220 | 107.20 | 2031.6 | 2996.4 | 41.37 | 11.72 | 16.17 | 1192 | 0.43 | 10299 |
| | 240 | 116.67 | 2265.9 | 3315.9 | 42.76 | 11.41 | 15.80 | 1244 | 0.39 | 11170 |
| | 260 | 126.10 | 2493.8 | 3628.7 | 44.01 | 11.14 | 15.49 | 1293 | 0.36 | 12034 |
| | 280 | 135.48 | 2716.6 | 3935.9 | 45.15 | 10.94 | 15.25 | 1341 | 0.33 | 12891 |
| | 300 | 144.83 | 2935.4 | 4238.9 | 46.19 | 10.78 | 15.06 | 1386 | 0.31 | 13744 |

* TWO PHASE BOUNDARY

TABLE VI. THERMODYNAMIC PROPERTIES OF PARAHYDROGEN

100 BAR ISOBAR

| | TEMPERATURE K | MOLAR VOLUME CM3/G | INTERNAL ENERGY J/G | ENTHALPY J/G | ENTROPY J/G-K | SPECIFIC HEAT CV J/G-K | SPECIFIC HEAT CP J/G-K | VELOCITY OF SOUND M/S | $\left(\frac{\partial P}{\partial T}\right)_V$ BAR/K | $\left(\frac{\partial P}{\partial \rho}\right)_T$ BAR-CM3/G |
|---|---|---|---|---|---|---|---|---|---|---|
| * | 16.808 | 12.22 | -302.1 | -179.9 | 5.18 | 5.03 | 6.58 | 1503 | 10.22 | 17451 |
| | 17 | 12.23 | -301.0 | -178.6 | 5.26 | 5.11 | 6.64 | 1501 | 10.21 | 17343 |
| | 18 | 12.32 | -295.1 | -171.8 | 5.65 | 5.27 | 6.96 | 1489 | 10.18 | 16783 |
| | 19 | 12.42 | -288.9 | -164.8 | 6.03 | 5.43 | 7.27 | 1476 | 10.12 | 16245 |
| | 20 | 12.51 | -282.5 | -157.3 | 6.41 | 5.57 | 7.61 | 1464 | 10.11 | 15674 |
| | 21 | 12.62 | -275.7 | -149.6 | 6.79 | 5.69 | 7.93 | 1450 | 10.06 | 15089 |
| | 22 | 12.73 | -268.7 | -141.5 | 7.17 | 5.80 | 8.25 | 1436 | 9.98 | 14505 |
| | 23 | 12.84 | -261.5 | -133.1 | 7.54 | 5.90 | 8.55 | 1424 | 9.88 | 14001 |
| | 24 | 12.96 | -254.0 | -124.4 | 7.91 | 5.99 | 8.84 | 1410 | 9.76 | 13482 |
| | 25 | 13.08 | -246.2 | -115.4 | 8.28 | 6.07 | 9.12 | 1399 | 9.63 | 13035 |
| | 26 | 13.21 | -238.2 | -106.1 | 8.64 | 6.14 | 9.41 | 1385 | 9.49 | 12516 |
| | 27 | 13.35 | -230.0 | -96.5 | 9.00 | 6.21 | 9.71 | 1370 | 9.34 | 12003 |
| | 28 | 13.49 | -221.6 | -86.7 | 9.36 | 6.28 | 10.01 | 1354 | 9.18 | 11496 |
| | 29 | 13.64 | -212.9 | -76.5 | 9.72 | 6.34 | 10.31 | 1338 | 9.00 | 11004 |
| | 30 | 13.79 | -204.0 | -66.1 | 10.07 | 6.39 | 10.60 | 1322 | 8.82 | 10533 |
| | 31 | 13.96 | -194.9 | -55.3 | 10.42 | 6.43 | 10.89 | 1307 | 8.63 | 10081 |
| | 32 | 14.13 | -185.6 | -44.3 | 10.77 | 6.48 | 11.19 | 1290 | 8.43 | 9631 |
| | 33 | 14.31 | -176.0 | -32.9 | 11.12 | 6.51 | 11.48 | 1273 | 8.22 | 9197 |
| | 34 | 14.49 | -166.3 | -21.3 | 11.47 | 6.55 | 11.77 | 1256 | 8.01 | 8773 |
| | 35 | 14.69 | -156.3 | -9.4 | 11.82 | 6.57 | 12.06 | 1239 | 7.79 | 8368 |
| | 36 | 14.90 | -146.2 | 2.8 | 12.16 | 6.60 | 12.34 | 1221 | 7.57 | 7979 |
| | 37 | 15.11 | -135.8 | 15.3 | 12.50 | 6.62 | 12.63 | 1204 | 7.35 | 7606 |
| | 38 | 15.34 | -125.3 | 28.0 | 12.84 | 6.64 | 12.91 | 1187 | 7.13 | 7254 |
| | 39 | 15.57 | -114.7 | 41.1 | 13.18 | 6.66 | 13.19 | 1170 | 6.91 | 6902 |
| | 40 | 15.82 | -103.8 | 54.4 | 13.52 | 6.67 | 13.46 | 1153 | 6.69 | 6589 |
| | 42 | 16.36 | -81.7 | 81.9 | 14.19 | 6.69 | 13.98 | 1121 | 6.25 | 6015 |
| | 44 | 16.94 | -59.1 | 110.3 | 14.85 | 6.70 | 14.48 | 1090 | 5.82 | 5502 |
| | 46 | 17.57 | -36.5 | 139.2 | 15.49 | 6.76 | 14.94 | 1059 | 5.41 | 5076 |
| | 48 | 18.25 | -13.0 | 169.5 | 16.14 | 6.81 | 15.35 | 1031 | 5.02 | 4710 |
| | 50 | 18.99 | 10.7 | 200.6 | 16.77 | 6.85 | 15.69 | 1005 | 4.65 | 4406 |
| | 55 | 21.04 | 70.2 | 280.6 | 18.29 | 6.95 | 16.23 | 953 | 3.85 | 3891 |
| | 60 | 23.34 | 128.9 | 362.3 | 19.72 | 7.04 | 16.30 | 920 | 3.22 | 3656 |
| | 65 | 25.81 | 185.3 | 443.4 | 21.01 | 7.17 | 16.09 | 901 | 2.73 | 3616 |
| | 70 | 28.35 | 239.6 | 523.1 | 22.20 | 7.36 | 15.76 | 891 | 2.35 | 3703 |
| | 75 | 30.91 | 292.2 | 601.2 | 23.27 | 7.61 | 15.51 | 886 | 2.06 | 3856 |
| | 80 | 33.45 | 343.8 | 678.4 | 24.27 | 7.92 | 15.38 | 886 | 1.83 | 4039 |
| | 85 | 35.98 | 395.3 | 755.1 | 25.20 | 8.27 | 15.35 | 888 | 1.65 | 4247 |
| | 90 | 38.49 | 447.1 | 832.0 | 26.08 | 8.66 | 15.42 | 892 | 1.51 | 4468 |
| | 95 | 40.97 | 499.7 | 909.4 | 26.92 | 9.06 | 15.54 | 898 | 1.38 | 4702 |
| | 100 | 43.42 | 553.3 | 987.5 | 27.72 | 9.48 | 15.71 | 905 | 1.28 | 4939 |
| | 110 | 48.25 | 665.8 | 1148.3 | 29.25 | 10.35 | 16.21 | 921 | 1.11 | 5423 |
| | 120 | 52.98 | 782.5 | 1312.2 | 30.68 | 11.06 | 16.61 | 942 | 0.99 | 5907 |
| | 130 | 57.63 | 903.6 | 1479.9 | 32.02 | 11.61 | 16.93 | 965 | 0.89 | 6389 |
| | 140 | 62.21 | 1028.1 | 1650.3 | 33.28 | 12.01 | 17.15 | 990 | 0.81 | 6862 |
| | 150 | 66.59 | 1154.6 | 1820.5 | 34.46 | 12.25 | 17.27 | 1014 | 0.74 | 7298 |
| | 160 | 71.05 | 1282.2 | 1992.7 | 35.57 | 12.36 | 17.21 | 1039 | 0.68 | 7762 |
| | 170 | 75.47 | 1409.6 | 2164.3 | 36.61 | 12.38 | 17.13 | 1067 | 0.64 | 8220 |
| | 180 | 79.85 | 1536.4 | 2334.9 | 37.58 | 12.31 | 16.99 | 1094 | 0.59 | 8673 |
| | 190 | 84.21 | 1661.8 | 2503.9 | 38.49 | 12.23 | 16.82 | 1121 | 0.56 | 9123 |
| | 200 | 88.55 | 1785.6 | 2671.0 | 39.35 | 12.05 | 16.62 | 1148 | 0.53 | 9569 |
| | 220 | 97.16 | 2027.6 | 2999.2 | 40.92 | 11.73 | 16.21 | 1202 | 0.47 | 10452 |
| | 240 | 105.71 | 2262.2 | 3319.3 | 42.31 | 11.41 | 15.83 | 1253 | 0.43 | 11326 |
| | 260 | 114.21 | 2490.5 | 3632.6 | 43.56 | 11.15 | 15.52 | 1302 | 0.40 | 12191 |
| | 280 | 122.67 | 2713.6 | 3940.3 | 44.70 | 10.94 | 15.27 | 1349 | 0.37 | 13051 |
| | 300 | 131.09 | 2932.7 | 4243.7 | 45.75 | 10.79 | 15.08 | 1394 | 0.34 | 13905 |

* TWO PHASE BOUNDARY

TABLE VI. THERMODYNAMIC PROPERTIES OF PARAHYDROGEN

| | 120 BAR ISOBAR TEMPERATURE K | MOLAR VOLUME CM3/G | INTERNAL ENERGY J/G | ENTHALPY J/G | ENTROPY J/G-K | SPECIFIC HEAT CV J/G-K | SPECIFIC HEAT CP J/G-K | VELOCITY OF SOUND M/S | $\left(\frac{\partial P}{\partial T}\right)_V$ BAR/K | $\left(\frac{\partial P}{\partial \rho}\right)_T$ BAR-CM3/G |
|---|---|---|---|---|---|---|---|---|---|---|
| * | 17.345 | 12.10 | -300.1 | -154.9 | 5.22 | 5.15 | 6.62 | 1542 | 10.36 | 18484 |
| | 18 | 12.15 | -296.4 | -150.5 | 5.47 | 5.26 | 6.83 | 1534 | 10.35 | 18132 |
| | 19 | 12.24 | -290.4 | -143.6 | 5.85 | 5.41 | 7.13 | 1523 | 10.33 | 17594 |
| | 20 | 12.33 | -284.2 | -136.3 | 6.22 | 5.54 | 7.43 | 1512 | 10.29 | 17058 |
| | 21 | 12.42 | -277.8 | -128.7 | 6.59 | 5.67 | 7.74 | 1501 | 10.27 | 16512 |
| | 22 | 12.52 | -271.1 | -120.9 | 6.96 | 5.79 | 8.04 | 1489 | 10.21 | 15975 |
| | 23 | 12.62 | -264.1 | -112.7 | 7.32 | 5.89 | 8.33 | 1477 | 10.13 | 15427 |
| | 24 | 12.73 | -256.9 | -104.2 | 7.68 | 5.98 | 8.61 | 1463 | 10.03 | 14864 |
| | 25 | 12.84 | -249.5 | -95.5 | 8.04 | 6.07 | 8.88 | 1451 | 9.92 | 14393 |
| | 26 | 12.95 | -241.9 | -86.5 | 8.39 | 6.14 | 9.15 | 1439 | 9.79 | 13902 |
| | 27 | 13.07 | -234.1 | -77.2 | 8.74 | 6.21 | 9.41 | 1427 | 9.65 | 13455 |
| | 28 | 13.20 | -226.0 | -67.6 | 9.09 | 6.28 | 9.68 | 1414 | 9.51 | 12978 |
| | 29 | 13.33 | -217.8 | -57.8 | 9.43 | 6.34 | 9.95 | 1400 | 9.35 | 12501 |
| | 30 | 13.46 | -209.3 | -47.7 | 9.77 | 6.40 | 10.22 | 1386 | 9.19 | 12025 |
| | 31 | 13.61 | -200.7 | -37.4 | 10.11 | 6.45 | 10.48 | 1371 | 9.02 | 11561 |
| | 32 | 13.75 | -191.8 | -26.8 | 10.45 | 6.49 | 10.74 | 1357 | 8.84 | 11138 |
| | 33 | 13.91 | -182.8 | -15.9 | 10.78 | 6.53 | 11.00 | 1343 | 8.66 | 10709 |
| | 34 | 14.07 | -173.6 | -4.8 | 11.12 | 6.57 | 11.26 | 1327 | 8.46 | 10289 |
| | 35 | 14.23 | -164.2 | 6.6 | 11.45 | 6.60 | 11.50 | 1313 | 8.27 | 9890 |
| | 36 | 14.40 | -154.6 | 18.2 | 11.77 | 6.63 | 11.76 | 1297 | 8.07 | 9496 |
| | 37 | 14.58 | -144.9 | 30.1 | 12.10 | 6.66 | 11.99 | 1282 | 7.87 | 9135 |
| | 38 | 14.77 | -135.0 | 42.2 | 12.42 | 6.68 | 12.22 | 1267 | 7.66 | 8777 |
| | 39 | 14.97 | -125.0 | 54.6 | 12.74 | 6.70 | 12.45 | 1252 | 7.45 | 8432 |
| | 40 | 15.17 | -114.9 | 67.1 | 13.06 | 6.71 | 12.68 | 1237 | 7.25 | 8102 |
| | 42 | 15.60 | -94.2 | 92.9 | 13.69 | 6.73 | 13.13 | 1207 | 6.84 | 7471 |
| | 44 | 16.06 | -73.1 | 119.6 | 14.31 | 6.76 | 13.56 | 1178 | 6.44 | 6919 |
| | 46 | 16.55 | -52.1 | 146.6 | 14.91 | 6.82 | 13.97 | 1150 | 6.05 | 6458 |
| | 48 | 17.09 | -30.1 | 174.9 | 15.51 | 6.86 | 14.34 | 1124 | 5.68 | 6043 |
| | 50 | 17.65 | -7.9 | 203.9 | 16.10 | 6.90 | 14.65 | 1099 | 5.32 | 5691 |
| | 55 | 19.21 | 48.2 | 278.8 | 17.53 | 7.01 | 15.26 | 1045 | 4.52 | 5016 |
| | 60 | 20.96 | 104.7 | 356.2 | 18.88 | 7.10 | 15.56 | 1007 | 3.85 | 4623 |
| | 65 | 22.86 | 160.0 | 434.2 | 20.13 | 7.23 | 15.63 | 979 | 3.31 | 4435 |
| | 70 | 24.85 | 214.1 | 512.3 | 21.29 | 7.42 | 15.59 | 961 | 2.88 | 4391 |
| | 75 | 26.89 | 267.3 | 590.3 | 22.36 | 7.67 | 15.49 | 949 | 2.54 | 4459 |
| | 80 | 28.95 | 319.8 | 667.3 | 23.36 | 7.97 | 15.43 | 943 | 2.26 | 4593 |
| | 85 | 31.01 | 372.2 | 744.4 | 24.29 | 8.32 | 15.45 | 940 | 2.04 | 4756 |
| | 90 | 33.07 | 425.0 | 821.9 | 25.18 | 8.70 | 15.54 | 939 | 1.85 | 4943 |
| | 95 | 35.11 | 478.6 | 899.9 | 26.02 | 9.10 | 15.69 | 941 | 1.70 | 5142 |
| | 100 | 37.14 | 533.1 | 978.8 | 26.83 | 9.51 | 15.88 | 945 | 1.57 | 5352 |
| | 110 | 41.16 | 647.4 | 1141.3 | 28.38 | 10.39 | 16.38 | 956 | 1.37 | 5801 |
| | 120 | 45.12 | 765.6 | 1307.3 | 29.92 | 11.09 | 16.78 | 973 | 1.21 | 6261 |
| | 130 | 49.01 | 888.1 | 1476.3 | 31.17 | 11.64 | 17.09 | 994 | 1.08 | 6732 |
| | 140 | 52.86 | 1013.9 | 1648.2 | 32.45 | 12.04 | 17.30 | 1017 | 0.98 | 7198 |
| | 150 | 56.65 | 1141.7 | 1821.6 | 33.64 | 12.28 | 17.38 | 1041 | 0.90 | 7664 |
| | 160 | 60.40 | 1270.4 | 1995.2 | 34.76 | 12.40 | 17.37 | 1067 | 0.83 | 8126 |
| | 170 | 64.12 | 1398.9 | 2168.3 | 35.81 | 12.41 | 17.27 | 1093 | 0.77 | 8582 |
| | 180 | 67.62 | 1526.3 | 2337.7 | 36.78 | 12.34 | 17.13 | 1116 | 0.72 | 8981 |
| | 190 | 71.27 | 1652.3 | 2507.6 | 37.70 | 12.22 | 16.91 | 1142 | 0.68 | 9432 |
| | 200 | 74.91 | 1776.7 | 2675.5 | 38.56 | 12.09 | 16.70 | 1169 | 0.64 | 9880 |
| | 220 | 82.12 | 2019.7 | 3005.1 | 40.13 | 11.75 | 16.28 | 1221 | 0.57 | 10766 |
| | 240 | 89.27 | 2255.2 | 3326.5 | 41.53 | 11.43 | 15.89 | 1272 | 0.52 | 11643 |
| | 260 | 96.38 | 2484.3 | 3640.8 | 42.79 | 11.17 | 15.57 | 1321 | 0.48 | 12512 |
| | 280 | 103.45 | 2708.0 | 3949.4 | 43.93 | 10.96 | 15.31 | 1367 | 0.44 | 13374 |
| | 300 | 110.50 | 2927.6 | 4253.6 | 44.98 | 10.80 | 15.12 | 1411 | 0.41 | 14230 |

* TWO PHASE BOUNDARY

TABLE VI. THERMODYNAMIC PROPERTIES OF PARAHYDROGEN

| 140 BAR ISOBAR TEMPERATURE K | MOLAR VOLUME $CM^3/G$ | INTERNAL ENERGY J/G | ENTHALPY J/G | ENTROPY J/G-K | SPECIFIC HEAT CV J/G-K | SPECIFIC HEAT CP J/G-K | VELOCITY OF SOUND M/S | $\left(\frac{\partial P}{\partial T}\right)_V$ BAR/K | $\left(\frac{\partial P}{\partial \rho}\right)_T$ BAR-$CM^3/G$ |
|---|---|---|---|---|---|---|---|---|---|
| * 17.869 | 11.99 | -298.0 | -130.2 | 5.26 | 5.21 | 6.67 | 1578 | 10.50 | 19488 |
| 18 | 12.00 | -297.3 | -129.3 | 5.31 | 5.24 | 6.71 | 1577 | 10.50 | 19420 |
| 19 | 12.08 | -291.5 | -122.5 | 5.68 | 5.39 | 7.00 | 1567 | 10.49 | 18900 |
| 20 | 12.16 | -285.5 | -115.3 | 6.05 | 5.52 | 7.29 | 1557 | 10.47 | 18381 |
| 21 | 12.24 | -279.3 | -107.9 | 6.41 | 5.65 | 7.57 | 1547 | 10.43 | 17863 |
| 22 | 12.33 | -272.8 | -100.2 | 6.77 | 5.77 | 7.85 | 1536 | 10.38 | 17347 |
| 23 | 12.42 | -266.2 | -92.2 | 7.12 | 5.87 | 8.14 | 1526 | 10.36 | 16806 |
| 24 | 12.52 | -259.3 | -84.0 | 7.47 | 5.97 | 8.41 | 1515 | 10.27 | 16299 |
| 25 | 12.62 | -252.1 | -75.4 | 7.82 | 6.06 | 8.67 | 1503 | 10.17 | 15786 |
| 26 | 12.73 | -244.8 | -66.6 | 8.17 | 6.14 | 8.93 | 1489 | 10.06 | 15246 |
| 27 | 12.84 | -237.3 | -57.6 | 8.51 | 6.21 | 9.18 | 1479 | 9.93 | 14801 |
| 28 | 12.95 | -229.5 | -48.3 | 8.85 | 6.29 | 9.43 | 1466 | 9.80 | 14334 |
| 29 | 13.06 | -221.6 | -38.7 | 9.18 | 6.35 | 9.67 | 1454 | 9.65 | 13880 |
| 30 | 13.19 | -213.5 | -28.9 | 9.51 | 6.40 | 9.91 | 1442 | 9.51 | 13441 |
| 31 | 13.31 | -205.2 | -18.9 | 9.84 | 6.46 | 10.16 | 1430 | 9.36 | 12997 |
| 32 | 13.44 | -196.8 | -8.6 | 10.17 | 6.51 | 10.40 | 1416 | 9.19 | 12549 |
| 33 | 13.58 | -188.1 | 1.9 | 10.49 | 6.55 | 10.63 | 1403 | 9.03 | 12135 |
| 34 | 13.72 | -179.3 | 12.7 | 10.81 | 6.59 | 10.87 | 1390 | 8.85 | 11723 |
| 35 | 13.86 | -170.4 | 23.7 | 11.13 | 6.63 | 11.09 | 1377 | 8.67 | 11321 |
| 36 | 14.01 | -161.3 | 34.9 | 11.45 | 6.66 | 11.32 | 1363 | 8.49 | 10926 |
| 37 | 14.16 | -152.0 | 46.3 | 11.76 | 6.69 | 11.53 | 1350 | 8.30 | 10569 |
| 38 | 14.33 | -142.6 | 57.9 | 12.07 | 6.71 | 11.74 | 1336 | 8.11 | 10213 |
| 39 | 14.49 | -133.1 | 69.8 | 12.38 | 6.73 | 11.94 | 1323 | 7.92 | 9865 |
| 40 | 14.66 | -123.5 | 81.8 | 12.68 | 6.74 | 12.14 | 1310 | 7.73 | 9530 |
| 42 | 15.02 | -103.9 | 106.5 | 13.28 | 6.77 | 12.51 | 1283 | 7.35 | 8910 |
| 44 | 15.41 | -83.8 | 131.9 | 13.88 | 6.80 | 12.89 | 1257 | 6.97 | 8334 |
| 46 | 15.82 | -63.9 | 157.5 | 14.44 | 6.87 | 13.29 | 1229 | 6.60 | 7800 |
| 48 | 16.25 | -43.1 | 184.4 | 15.02 | 6.91 | 13.63 | 1204 | 6.24 | 7352 |
| 50 | 16.71 | -22.0 | 212.0 | 15.58 | 6.96 | 13.93 | 1180 | 5.89 | 6958 |
| 55 | 17.97 | 31.6 | 283.2 | 16.94 | 7.06 | 14.53 | 1128 | 5.10 | 6179 |
| 60 | 19.38 | 86.0 | 357.2 | 18.23 | 7.15 | 14.92 | 1086 | 4.42 | 5657 |
| 65 | 20.90 | 139.9 | 432.4 | 19.43 | 7.29 | 15.15 | 1054 | 3.85 | 5344 |
| 70 | 22.51 | 193.4 | 508.4 | 20.56 | 7.48 | 15.26 | 1030 | 3.38 | 5199 |
| 75 | 24.18 | 246.4 | 584.9 | 21.61 | 7.72 | 15.32 | 1012 | 2.99 | 5165 |
| 80 | 25.89 | 299.3 | 661.7 | 22.60 | 8.02 | 15.38 | 1000 | 2.68 | 5222 |
| 85 | 27.61 | 352.2 | 738.8 | 23.54 | 8.37 | 15.45 | 992 | 2.41 | 5335 |
| 90 | 29.34 | 405.6 | 816.3 | 24.42 | 8.75 | 15.58 | 988 | 2.20 | 5480 |
| 95 | 31.06 | 459.8 | 894.6 | 25.27 | 9.15 | 15.76 | 986 | 2.02 | 5648 |
| 100 | 32.78 | 515.0 | 974.0 | 26.08 | 9.55 | 15.96 | 987 | 1.86 | 5834 |
| 110 | 36.20 | 630.6 | 1137.4 | 27.64 | 10.43 | 16.49 | 993 | 1.62 | 6234 |
| 120 | 39.58 | 750.0 | 1304.2 | 29.09 | 11.12 | 16.90 | 1006 | 1.43 | 6667 |
| 130 | 42.93 | 873.7 | 1474.7 | 30.46 | 11.69 | 17.21 | 1024 | 1.28 | 7113 |
| 140 | 46.23 | 1000.6 | 1647.9 | 31.74 | 12.07 | 17.42 | 1045 | 1.16 | 7567 |
| 150 | 49.50 | 1129.4 | 1822.4 | 32.94 | 12.32 | 17.50 | 1068 | 1.06 | 8024 |
| 160 | 52.73 | 1259.0 | 1997.2 | 34.07 | 12.43 | 17.47 | 1092 | 0.98 | 8477 |
| 170 | 55.93 | 1388.3 | 2171.3 | 35.13 | 12.44 | 17.37 | 1117 | 0.91 | 8931 |
| 180 | 59.10 | 1516.7 | 2344.1 | 36.12 | 12.37 | 17.20 | 1142 | 0.85 | 9382 |
| 190 | 62.25 | 1643.5 | 2514.9 | 37.04 | 12.26 | 17.00 | 1167 | 0.80 | 9825 |
| 200 | 65.37 | 1768.5 | 2683.7 | 37.90 | 12.10 | 16.77 | 1193 | 0.75 | 10275 |
| 220 | 71.39 | 2012.2 | 3011.6 | 39.47 | 11.77 | 16.34 | 1241 | 0.67 | 11090 |
| 240 | 77.54 | 2248.6 | 3334.2 | 40.87 | 11.45 | 15.94 | 1291 | 0.61 | 11968 |
| 260 | 83.66 | 2478.2 | 3649.4 | 42.13 | 11.19 | 15.61 | 1339 | 0.56 | 12939 |
| 280 | 89.74 | 2702.6 | 3958.9 | 43.28 | 10.97 | 15.35 | 1385 | 0.52 | 13702 |
| 300 | 95.79 | 2922.7 | 4263.8 | 44.33 | 10.81 | 15.16 | 1429 | 0.48 | 14561 |

* TWO PHASE BOUNDARY

TABLE VI. THERMODYNAMIC PROPERTIES OF PARAHYDROGEN

| 160 BAR ISOBAR TEMPERATURE K | MOLAR VOLUME $CM^3/G$ | INTERNAL ENERGY J/G | ENTHALPY J/G | ENTROPY J/G-K | SPECIFIC HEAT CV J/G-K | SPECIFIC HEAT CP J/G-K | VELOCITY OF SOUND M/S | $\left(\frac{\partial P}{\partial T}\right)_V$ BAR/K | $\left(\frac{\partial P}{\partial \rho}\right)_T$ BAR-$CM^3$/G |
|---|---|---|---|---|---|---|---|---|---|
| * 18.378 | 11.88 | -295.8 | -105.7 | 5.30 | 5.27 | 6.71 | 1614 | 10.65 | 20467 |
| 19 | 11.93 | -292.3 | -101.4 | 5.52 | 5.37 | 6.89 | 1608 | 10.65 | 20154 |
| 20 | 12.00 | -286.5 | -94.4 | 5.88 | 5.51 | 7.16 | 1599 | 10.63 | 19650 |
| 21 | 12.08 | -280.4 | -87.1 | 6.24 | 5.63 | 7.44 | 1590 | 10.61 | 19146 |
| 22 | 12.17 | -274.2 | -79.5 | 6.59 | 5.75 | 7.70 | 1580 | 10.57 | 18644 |
| 23 | 12.25 | -267.7 | -71.7 | 6.94 | 5.86 | 7.96 | 1570 | 10.51 | 18144 |
| 24 | 12.34 | -261.0 | -63.6 | 7.28 | 5.96 | 8.22 | 1560 | 10.44 | 17648 |
| 25 | 12.43 | -254.2 | -55.3 | 7.62 | 6.05 | 8.49 | 1550 | 10.41 | 17121 |
| 26 | 12.53 | -247.1 | -46.7 | 7.96 | 6.13 | 8.74 | 1540 | 10.31 | 16643 |
| 27 | 12.63 | -239.8 | -37.8 | 8.30 | 6.21 | 8.98 | 1528 | 10.20 | 16160 |
| 28 | 12.73 | -232.3 | -28.7 | 8.63 | 6.28 | 9.22 | 1515 | 10.07 | 15646 |
| 29 | 12.83 | -224.7 | -19.4 | 8.96 | 6.35 | 9.45 | 1505 | 9.94 | 15220 |
| 30 | 12.94 | -216.9 | -9.8 | 9.28 | 6.41 | 9.67 | 1493 | 9.80 | 14777 |
| 31 | 13.06 | -208.9 | -0.0 | 9.60 | 6.47 | 9.90 | 1481 | 9.65 | 14315 |
| 32 | 13.17 | -200.8 | 10.0 | 9.92 | 6.52 | 10.12 | 1470 | 9.50 | 13908 |
| 33 | 13.29 | -192.5 | 20.2 | 10.23 | 6.56 | 10.34 | 1458 | 9.35 | 13493 |
| 34 | 13.42 | -184.0 | 30.7 | 10.55 | 6.61 | 10.56 | 1446 | 9.19 | 13074 |
| 35 | 13.55 | -175.4 | 41.4 | 10.85 | 6.65 | 10.77 | 1434 | 9.03 | 12691 |
| 36 | 13.68 | -166.6 | 52.2 | 11.16 | 6.68 | 10.98 | 1421 | 8.86 | 12300 |
| 37 | 13.82 | -157.8 | 63.3 | 11.46 | 6.71 | 11.18 | 1409 | 8.68 | 11922 |
| 38 | 13.96 | -148.7 | 74.6 | 11.77 | 6.74 | 11.37 | 1397 | 8.51 | 11572 |
| 39 | 14.10 | -139.6 | 86.0 | 12.06 | 6.76 | 11.56 | 1385 | 8.33 | 11224 |
| 40 | 14.25 | -130.3 | 97.7 | 12.36 | 6.78 | 11.73 | 1373 | 8.15 | 10892 |
| 42 | 14.57 | -111.5 | 121.5 | 12.94 | 6.81 | 12.07 | 1349 | 7.79 | 10266 |
| 44 | 14.90 | -92.4 | 146.0 | 13.51 | 6.84 | 12.41 | 1325 | 7.43 | 9677 |
| 46 | 15.25 | -73.3 | 170.6 | 14.06 | 6.91 | 12.76 | 1300 | 7.07 | 9145 |
| 48 | 15.62 | -53.4 | 196.5 | 14.61 | 6.96 | 13.10 | 1275 | 6.73 | 8634 |
| 50 | 16.01 | -33.1 | 223.0 | 15.15 | 7.01 | 13.41 | 1251 | 6.39 | 8177 |
| 55 | 17.06 | 18.5 | 291.5 | 16.45 | 7.11 | 13.98 | 1200 | 5.61 | 7333 |
| 60 | 18.23 | 71.1 | 362.7 | 17.69 | 7.20 | 14.39 | 1159 | 4.92 | 6720 |
| 65 | 19.49 | 123.6 | 435.5 | 18.86 | 7.34 | 14.71 | 1124 | 4.34 | 6302 |
| 70 | 20.84 | 176.2 | 509.6 | 19.95 | 7.53 | 14.93 | 1096 | 3.84 | 6057 |
| 75 | 22.24 | 228.9 | 584.7 | 20.99 | 7.78 | 15.09 | 1074 | 3.42 | 5943 |
| 80 | 23.68 | 281.6 | 660.5 | 21.97 | 8.08 | 15.26 | 1057 | 3.08 | 5913 |
| 85 | 25.15 | 334.8 | 737.2 | 22.90 | 8.42 | 15.40 | 1045 | 2.78 | 5968 |
| 90 | 26.63 | 388.5 | 814.6 | 23.78 | 8.80 | 15.57 | 1037 | 2.54 | 6071 |
| 95 | 28.11 | 443.2 | 893.0 | 24.63 | 9.19 | 15.77 | 1032 | 2.33 | 6209 |
| 100 | 29.60 | 498.8 | 972.3 | 25.45 | 9.60 | 15.99 | 1030 | 2.16 | 6362 |
| 110 | 32.56 | 615.4 | 1136.3 | 27.01 | 10.46 | 16.55 | 1030 | 1.87 | 6716 |
| 120 | 35.50 | 735.8 | 1303.8 | 28.46 | 11.16 | 16.98 | 1040 | 1.65 | 7106 |
| 130 | 38.42 | 860.4 | 1475.2 | 29.84 | 11.71 | 17.31 | 1055 | 1.48 | 7529 |
| 140 | 41.31 | 988.2 | 1649.2 | 31.13 | 12.11 | 17.51 | 1073 | 1.34 | 7967 |
| 150 | 44.17 | 1117.9 | 1824.6 | 32.34 | 12.35 | 17.59 | 1094 | 1.23 | 8408 |
| 160 | 47.01 | 1248.3 | 2000.4 | 33.47 | 12.46 | 17.56 | 1117 | 1.13 | 8856 |
| 170 | 49.81 | 1378.4 | 2175.4 | 34.53 | 12.47 | 17.46 | 1141 | 1.05 | 9299 |
| 180 | 52.60 | 1507.4 | 2349.0 | 35.52 | 12.41 | 17.29 | 1165 | 0.98 | 9745 |
| 190 | 55.36 | 1634.9 | 2520.7 | 36.45 | 12.29 | 17.08 | 1190 | 0.92 | 10190 |
| 200 | 58.11 | 1760.5 | 2690.2 | 37.32 | 12.14 | 16.84 | 1215 | 0.86 | 10634 |
| 220 | 63.54 | 2005.5 | 3022.1 | 38.90 | 11.80 | 16.37 | 1264 | 0.77 | 11506 |
| 240 | 68.75 | 2242.2 | 3342.3 | 40.30 | 11.47 | 15.98 | 1309 | 0.70 | 12300 |
| 260 | 74.12 | 2472.5 | 3658.4 | 41.56 | 11.20 | 15.66 | 1357 | 0.64 | 13171 |
| 280 | 79.46 | 2697.4 | 3968.7 | 42.71 | 10.99 | 15.39 | 1402 | 0.59 | 14036 |
| 300 | 84.76 | 2918.0 | 4274.2 | 43.77 | 10.82 | 15.19 | 1446 | 0.55 | 14896 |

* TWO PHASE BOUNDARY

TABLE VI. THERMODYNAMIC PROPERTIES OF PARAHYDROGEN

| | 180 BAR ISOBAR TEMPERATURE K | MOLAR VOLUME $CM^3/G$ | INTERNAL ENERGY J/G | ENTHALPY J/G | ENTROPY J/G-K | SPECIFIC HEAT CV J/G-K | SPECIFIC HEAT CP J/G-K | VELOCITY OF SOUND M/S | $\left(\frac{\partial P}{\partial T}\right)_V$ BAR/K | $\left(\frac{\partial P}{\partial \rho}\right)_T$ BAR-$CM^3$/G |
|---|---|---|---|---|---|---|---|---|---|---|
| * | 18.874 | 11.78 | -293.4 | -81.3 | 5.33 | 5.33 | 6.75 | 1648 | 10.79 | 21424 |
| | 19 | 11.79 | -292.7 | -80.5 | 5.38 | 5.35 | 6.79 | 1647 | 10.79 | 21362 |
| | 20 | 11.86 | -287.1 | -73.5 | 5.73 | 5.49 | 7.06 | 1638 | 10.79 | 20873 |
| | 21 | 11.94 | -281.2 | -66.4 | 6.08 | 5.62 | 7.32 | 1630 | 10.77 | 20383 |
| | 22 | 12.01 | -275.2 | -58.9 | 6.43 | 5.73 | 7.58 | 1621 | 10.74 | 19893 |
| | 23 | 12.09 | -268.9 | -51.2 | 6.77 | 5.84 | 7.83 | 1612 | 10.70 | 19404 |
| | 24 | 12.18 | -262.4 | -43.3 | 7.11 | 5.94 | 8.07 | 1603 | 10.64 | 18918 |
| | 25 | 12.26 | -255.7 | -35.1 | 7.45 | 6.04 | 8.32 | 1593 | 10.57 | 18435 |
| | 26 | 12.35 | -248.9 | -26.6 | 7.78 | 6.12 | 8.55 | 1584 | 10.49 | 17958 |
| | 27 | 12.44 | -241.8 | -17.9 | 8.10 | 6.20 | 8.81 | 1574 | 10.43 | 17453 |
| | 28 | 12.53 | -234.6 | -9.0 | 8.43 | 6.28 | 9.04 | 1564 | 10.32 | 17002 |
| | 29 | 12.63 | -227.2 | 0.1 | 8.75 | 6.35 | 9.26 | 1553 | 10.20 | 16544 |
| | 30 | 12.73 | -219.6 | 9.5 | 9.07 | 6.41 | 9.48 | 1541 | 10.07 | 16058 |
| | 31 | 12.83 | -211.9 | 19.1 | 9.38 | 6.47 | 9.69 | 1531 | 9.93 | 15652 |
| | 32 | 12.94 | -204.0 | 28.9 | 9.69 | 6.52 | 9.90 | 1520 | 9.79 | 15228 |
| | 33 | 13.05 | -196.0 | 38.9 | 10.00 | 6.57 | 10.10 | 1508 | 9.64 | 14808 |
| | 34 | 13.16 | -187.8 | 49.1 | 10.30 | 6.62 | 10.31 | 1497 | 9.50 | 14382 |
| | 35 | 13.28 | -179.5 | 59.5 | 10.61 | 6.66 | 10.51 | 1486 | 9.34 | 13993 |
| | 36 | 13.40 | -171.0 | 70.1 | 10.91 | 6.70 | 10.70 | 1475 | 9.19 | 13618 |
| | 37 | 13.52 | -162.4 | 80.9 | 11.20 | 6.73 | 10.89 | 1463 | 9.02 | 13243 |
| | 38 | 13.65 | -153.7 | 91.9 | 11.49 | 6.76 | 11.08 | 1452 | 8.86 | 12874 |
| | 39 | 13.78 | -144.9 | 103.0 | 11.78 | 6.79 | 11.25 | 1441 | 8.69 | 12534 |
| | 40 | 13.91 | -136.0 | 114.4 | 12.07 | 6.80 | 11.41 | 1430 | 8.52 | 12194 |
| | 42 | 14.19 | -117.8 | 137.5 | 12.64 | 6.84 | 11.74 | 1408 | 8.18 | 11549 |
| | 44 | 14.48 | -99.3 | 161.3 | 13.19 | 6.87 | 12.04 | 1386 | 7.84 | 10970 |
| | 46 | 14.79 | -81.0 | 185.2 | 13.72 | 6.94 | 12.37 | 1363 | 7.50 | 10428 |
| | 48 | 15.11 | -61.7 | 210.2 | 14.25 | 7.00 | 12.67 | 1340 | 7.17 | 9915 |
| | 50 | 15.45 | -42.2 | 235.9 | 14.77 | 7.05 | 12.95 | 1318 | 6.84 | 9455 |
| | 55 | 16.36 | 7.8 | 302.2 | 16.04 | 7.16 | 13.55 | 1267 | 6.07 | 8487 |
| | 60 | 17.36 | 58.9 | 371.3 | 17.24 | 7.26 | 13.97 | 1225 | 5.38 | 7795 |
| | 65 | 18.43 | 110.2 | 442.1 | 18.37 | 7.39 | 14.32 | 1189 | 4.78 | 7290 |
| | 70 | 19.58 | 161.9 | 514.4 | 19.45 | 7.59 | 14.61 | 1158 | 4.27 | 6963 |
| | 75 | 20.78 | 214.0 | 588.0 | 20.46 | 7.83 | 14.86 | 1133 | 3.83 | 6763 |
| | 80 | 22.02 | 266.5 | 662.9 | 21.43 | 8.12 | 15.08 | 1113 | 3.46 | 6678 |
| | 85 | 23.29 | 319.6 | 738.8 | 22.35 | 8.47 | 15.30 | 1097 | 3.14 | 6664 |
| | 90 | 24.58 | 373.5 | 815.9 | 23.23 | 8.84 | 15.52 | 1085 | 2.87 | 6711 |
| | 95 | 25.87 | 428.4 | 894.1 | 24.08 | 9.24 | 15.75 | 1077 | 2.64 | 6806 |
| | 100 | 27.17 | 484.3 | 973.4 | 24.89 | 9.64 | 16.00 | 1072 | 2.44 | 6927 |
| | 110 | 29.77 | 601.6 | 1137.5 | 26.45 | 10.50 | 16.57 | 1069 | 2.12 | 7236 |
| | 120 | 32.37 | 722.7 | 1305.4 | 27.91 | 11.19 | 17.03 | 1074 | 1.88 | 7588 |
| | 130 | 34.95 | 848.1 | 1477.3 | 29.29 | 11.74 | 17.37 | 1086 | 1.68 | 7980 |
| | 140 | 37.52 | 976.7 | 1652.0 | 30.58 | 12.14 | 17.58 | 1102 | 1.52 | 8392 |
| | 150 | 40.06 | 1107.1 | 1828.2 | 31.80 | 12.39 | 17.66 | 1122 | 1.39 | 8818 |
| | 160 | 42.58 | 1238.2 | 2004.7 | 32.94 | 12.49 | 17.64 | 1143 | 1.28 | 9253 |
| | 170 | 45.08 | 1369.0 | 2180.5 | 34.00 | 12.51 | 17.53 | 1165 | 1.19 | 9690 |
| | 180 | 47.56 | 1498.7 | 2354.8 | 35.00 | 12.44 | 17.36 | 1189 | 1.11 | 10129 |
| | 190 | 50.02 | 1626.8 | 2527.2 | 35.93 | 12.32 | 17.15 | 1212 | 1.04 | 10565 |
| | 200 | 52.47 | 1753.0 | 2697.4 | 36.80 | 12.17 | 16.91 | 1236 | 0.97 | 11002 |
| | 220 | 57.31 | 1999.1 | 3030.6 | 38.39 | 11.83 | 16.43 | 1284 | 0.87 | 11875 |
| | 240 | 62.09 | 2236.9 | 3354.5 | 39.80 | 11.50 | 16.00 | 1331 | 0.79 | 12729 |
| | 260 | 66.71 | 2467.3 | 3668.0 | 41.06 | 11.22 | 15.66 | 1373 | 0.72 | 13509 |
| | 280 | 71.46 | 2692.4 | 3978.7 | 42.21 | 11.00 | 15.43 | 1420 | 0.67 | 14374 |
| | 300 | 76.19 | 2913.5 | 4284.9 | 43.27 | 10.84 | 15.22 | 1463 | 0.62 | 15234 |

* TWO PHASE BOUNDARY

TABLE VI. THERMODYNAMIC PROPERTIES OF PARAHYDROGEN

| 200 BAR ISOBAR TEMPERATURE K | MOLAR VOLUME $CM^3/G$ | INTERNAL ENERGY J/G | ENTHALPY J/G | ENTROPY J/G-K | SPECIFIC HEAT CV J/G-K | SPECIFIC HEAT CP J/G-K | VELOCITY OF SOUND M/S | $\left(\frac{\partial P}{\partial T}\right)_V$ BAR/K | $\left(\frac{\partial P}{\partial \rho}\right)_T$ BAR-$CM^3/G$ |
|---|---|---|---|---|---|---|---|---|---|
| * 19.360 | 11.69 | -291.0 | -57.2 | 5.37 | 5.38 | 6.79 | 1681 | 10.94 | 22361 |
| 20 | 11.73 | -287.4 | -52.8 | 5.59 | 5.47 | 6.96 | 1676 | 10.94 | 22056 |
| 21 | 11.80 | -281.7 | -45.7 | 5.94 | 5.60 | 7.22 | 1668 | 10.93 | 21579 |
| 22 | 11.88 | -275.8 | -38.3 | 6.28 | 5.72 | 7.47 | 1660 | 10.91 | 21101 |
| 23 | 11.95 | -269.7 | -30.7 | 6.62 | 5.83 | 7.71 | 1652 | 10.87 | 20623 |
| 24 | 12.03 | -263.4 | -22.9 | 6.95 | 5.93 | 7.95 | 1643 | 10.82 | 20146 |
| 25 | 12.10 | -256.9 | -14.8 | 7.28 | 6.02 | 8.18 | 1634 | 10.76 | 19672 |
| 26 | 12.19 | -250.3 | -6.6 | 7.60 | 6.11 | 8.41 | 1625 | 10.69 | 19201 |
| 27 | 12.27 | -243.4 | 2.0 | 7.93 | 6.20 | 8.64 | 1616 | 10.61 | 18735 |
| 28 | 12.36 | -236.4 | 10.7 | 8.24 | 6.28 | 8.86 | 1607 | 10.52 | 18276 |
| 29 | 12.45 | -229.2 | 19.7 | 8.56 | 6.35 | 9.10 | 1597 | 10.44 | 17799 |
| 30 | 12.54 | -221.8 | 28.9 | 8.87 | 6.41 | 9.30 | 1588 | 10.32 | 17371 |
| 31 | 12.63 | -214.3 | 38.3 | 9.18 | 6.47 | 9.51 | 1577 | 10.19 | 16939 |
| 32 | 12.73 | -206.7 | 47.9 | 9.49 | 6.53 | 9.71 | 1566 | 10.06 | 16482 |
| 33 | 12.83 | -198.9 | 57.8 | 9.79 | 6.58 | 9.90 | 1556 | 9.92 | 16090 |
| 34 | 12.93 | -190.9 | 67.8 | 10.09 | 6.63 | 10.09 | 1546 | 9.78 | 15687 |
| 35 | 13.04 | -182.9 | 78.0 | 10.38 | 6.67 | 10.29 | 1535 | 9.63 | 15279 |
| 36 | 13.15 | -174.6 | 88.3 | 10.67 | 6.71 | 10.48 | 1523 | 9.48 | 14863 |
| 37 | 13.26 | -166.3 | 98.9 | 10.96 | 6.75 | 10.66 | 1513 | 9.33 | 14496 |
| 38 | 13.38 | -157.9 | 109.6 | 11.25 | 6.78 | 10.83 | 1503 | 9.18 | 14147 |
| 39 | 13.49 | -149.3 | 120.6 | 11.53 | 6.81 | 10.99 | 1493 | 9.02 | 13794 |
| 40 | 13.61 | -140.6 | 131.6 | 11.81 | 6.83 | 11.15 | 1482 | 8.86 | 13445 |
| 42 | 13.86 | -123.0 | 154.2 | 12.37 | 6.87 | 11.46 | 1462 | 8.53 | 12804 |
| 44 | 14.13 | -105.1 | 177.4 | 12.91 | 6.90 | 11.75 | 1441 | 8.21 | 12211 |
| 46 | 14.40 | -87.3 | 200.7 | 13.42 | 6.98 | 12.06 | 1419 | 7.88 | 11651 |
| 48 | 14.69 | -68.6 | 225.1 | 13.94 | 7.03 | 12.34 | 1398 | 7.56 | 11147 |
| 50 | 14.99 | -49.6 | 250.1 | 14.45 | 7.09 | 12.60 | 1378 | 7.24 | 10672 |
| 55 | 15.79 | -1.1 | 314.6 | 15.68 | 7.20 | 13.20 | 1328 | 6.49 | 9632 |
| 60 | 16.66 | 48.8 | 382.0 | 16.85 | 7.30 | 13.63 | 1286 | 5.80 | 8864 |
| 65 | 17.60 | 99.0 | 451.1 | 17.96 | 7.44 | 13.99 | 1249 | 5.20 | 8299 |
| 70 | 18.60 | 149.9 | 521.8 | 19.01 | 7.63 | 14.32 | 1217 | 4.67 | 7894 |
| 75 | 19.64 | 201.3 | 594.2 | 20.01 | 7.87 | 14.62 | 1190 | 4.22 | 7626 |
| 80 | 20.73 | 253.4 | 668.0 | 20.96 | 8.17 | 14.90 | 1167 | 3.82 | 7462 |
| 85 | 21.84 | 306.3 | 743.1 | 21.87 | 8.51 | 15.17 | 1148 | 3.49 | 7399 |
| 90 | 22.97 | 360.2 | 819.7 | 22.74 | 8.89 | 15.44 | 1134 | 3.19 | 7397 |
| 95 | 24.12 | 415.2 | 897.6 | 23.59 | 9.29 | 15.71 | 1123 | 2.94 | 7445 |
| 100 | 25.27 | 471.3 | 976.8 | 24.40 | 9.68 | 15.97 | 1115 | 2.73 | 7533 |
| 110 | 27.59 | 589.1 | 1140.8 | 25.96 | 10.54 | 16.58 | 1107 | 2.37 | 7788 |
| 120 | 29.90 | 710.8 | 1308.8 | 27.42 | 11.23 | 17.04 | 1109 | 2.10 | 8102 |
| 130 | 32.21 | 836.8 | 1481.0 | 28.80 | 11.77 | 17.41 | 1118 | 1.88 | 8452 |
| 140 | 34.51 | 966.0 | 1656.2 | 30.10 | 12.17 | 17.63 | 1132 | 1.70 | 8843 |
| 150 | 36.80 | 1097.0 | 1832.9 | 31.32 | 12.41 | 17.72 | 1149 | 1.56 | 9246 |
| 160 | 39.06 | 1228.7 | 2010.0 | 32.46 | 12.53 | 17.70 | 1169 | 1.43 | 9670 |
| 170 | 41.32 | 1360.1 | 2186.4 | 33.53 | 12.54 | 17.59 | 1190 | 1.33 | 10097 |
| 180 | 43.55 | 1490.4 | 2361.4 | 34.53 | 12.47 | 17.42 | 1212 | 1.24 | 10522 |
| 190 | 45.77 | 1619.1 | 2534.4 | 35.47 | 12.35 | 17.21 | 1235 | 1.16 | 10957 |
| 200 | 47.97 | 1745.8 | 2705.2 | 36.34 | 12.20 | 16.97 | 1259 | 1.09 | 11391 |
| 220 | 52.33 | 1992.9 | 3039.6 | 37.94 | 11.86 | 16.49 | 1305 | 0.97 | 12246 |
| 240 | 56.65 | 2231.7 | 3364.6 | 39.35 | 11.53 | 16.05 | 1350 | 0.88 | 13106 |
| 260 | 60.92 | 2463.1 | 3681.4 | 40.62 | 11.25 | 15.67 | 1394 | 0.80 | 13951 |
| 280 | 65.15 | 2688.5 | 3991.5 | 41.77 | 11.03 | 15.37 | 1436 | 0.74 | 14794 |
| 300 | 69.33 | 2909.3 | 4295.9 | 42.82 | 10.85 | 15.22 | 1478 | 0.69 | 15576 |

* TWO PHASE BOUNDARY

TABLE VI. THERMODYNAMIC PROPERTIES OF PARAHYDROGEN

| | 220 BAR ISOBAR TEMPERATURE K | MOLAR VOLUME $CM^3/G$ | INTERNAL ENERGY J/G | ENTHALPY J/G | ENTROPY J/G-K | SPECIFIC HEAT CV J/G-K | SPECIFIC HEAT CP J/G-K | VELOCITY OF SOUND M/S | $\left(\frac{\partial P}{\partial T}\right)_V$ BAR/K | $\left(\frac{\partial P}{\partial \rho}\right)_T$ BAR-$CM^3/G$ |
|---|---|---|---|---|---|---|---|---|---|---|
| * | 19.835 | 11.60 | -288.5 | -33.2 | 5.40 | 5.42 | 6.83 | 1712 | 11.08 | 23280 |
| | 20 | 11.61 | -287.6 | -32.1 | 5.46 | 5.45 | 6.87 | 1711 | 11.08 | 23204 |
| | 21 | 11.68 | -282.0 | -25.1 | 5.80 | 5.53 | 7.13 | 1704 | 11.08 | 22739 |
| | 22 | 11.75 | -276.2 | -17.8 | 6.14 | 5.70 | 7.37 | 1697 | 11.07 | 22273 |
| | 23 | 11.82 | -270.3 | -10.3 | 6.47 | 5.81 | 7.61 | 1689 | 11.04 | 21806 |
| | 24 | 11.89 | -264.1 | -2.6 | 6.80 | 5.92 | 7.84 | 1681 | 11.00 | 21338 |
| | 25 | 11.96 | -257.8 | 5.3 | 7.12 | 6.01 | 8.06 | 1673 | 10.94 | 20872 |
| | 26 | 12.04 | -251.3 | 13.5 | 7.44 | 6.10 | 8.29 | 1665 | 10.88 | 20408 |
| | 27 | 12.12 | -244.6 | 21.9 | 7.76 | 6.19 | 8.51 | 1656 | 10.81 | 19948 |
| | 28 | 12.20 | -237.8 | 30.5 | 8.08 | 6.27 | 8.73 | 1647 | 10.72 | 19492 |
| | 29 | 12.28 | -230.8 | 39.4 | 8.39 | 6.34 | 8.94 | 1638 | 10.63 | 19044 |
| | 30 | 12.37 | -223.6 | 48.4 | 8.69 | 6.41 | 9.15 | 1629 | 10.53 | 18603 |
| | 31 | 12.45 | -216.3 | 57.7 | 9.00 | 6.47 | 9.36 | 1620 | 10.43 | 18159 |
| | 32 | 12.54 | -208.8 | 67.1 | 9.30 | 6.53 | 9.55 | 1611 | 10.31 | 17750 |
| | 33 | 12.64 | -201.2 | 76.8 | 9.59 | 6.59 | 9.73 | 1601 | 10.18 | 17340 |
| | 34 | 12.73 | -193.5 | 86.6 | 9.89 | 6.64 | 9.92 | 1590 | 10.04 | 16913 |
| | 35 | 12.83 | -185.6 | 96.6 | 10.18 | 6.68 | 10.10 | 1581 | 9.90 | 16536 |
| | 36 | 12.93 | -177.6 | 106.8 | 10.46 | 6.72 | 10.27 | 1571 | 9.76 | 16152 |
| | 37 | 13.03 | -169.5 | 117.2 | 10.75 | 6.76 | 10.45 | 1560 | 9.61 | 15757 |
| | 38 | 13.14 | -161.3 | 127.7 | 11.03 | 6.80 | 10.63 | 1549 | 9.47 | 15352 |
| | 39 | 13.24 | -153.0 | 138.4 | 11.31 | 6.82 | 10.78 | 1540 | 9.32 | 15002 |
| | 40 | 13.35 | -144.5 | 149.3 | 11.58 | 6.85 | 10.93 | 1531 | 9.17 | 14678 |
| | 42 | 13.58 | -127.4 | 171.4 | 12.12 | 6.89 | 11.22 | 1512 | 8.86 | 14032 |
| | 44 | 13.82 | -109.9 | 194.1 | 12.65 | 6.93 | 11.51 | 1492 | 8.54 | 13407 |
| | 46 | 14.07 | -92.6 | 216.9 | 13.16 | 7.01 | 11.80 | 1471 | 8.23 | 12849 |
| | 48 | 14.33 | -74.4 | 240.8 | 13.66 | 7.07 | 12.07 | 1451 | 7.92 | 12333 |
| | 50 | 14.60 | -55.9 | 265.2 | 14.16 | 7.12 | 12.33 | 1432 | 7.61 | 11840 |
| | 55 | 15.31 | -8.6 | 328.3 | 15.36 | 7.24 | 12.89 | 1386 | 6.87 | 10786 |
| | 60 | 16.09 | 40.2 | 394.2 | 16.51 | 7.34 | 13.34 | 1343 | 6.19 | 9928 |
| | 65 | 16.92 | 89.5 | 461.8 | 17.59 | 7.44 | 13.72 | 1306 | 5.58 | 9300 |
| | 70 | 17.81 | 139.6 | 531.3 | 18.62 | 7.67 | 14.07 | 1273 | 5.05 | 8832 |
| | 75 | 18.73 | 190.4 | 602.4 | 19.60 | 7.92 | 14.40 | 1243 | 4.58 | 8499 |
| | 80 | 19.69 | 242.0 | 675.2 | 20.54 | 8.21 | 14.72 | 1219 | 4.17 | 8292 |
| | 85 | 20.68 | 294.7 | 749.6 | 21.45 | 8.56 | 15.04 | 1197 | 3.81 | 8157 |
| | 90 | 21.69 | 348.5 | 825.6 | 22.31 | 8.93 | 15.34 | 1181 | 3.51 | 8111 |
| | 95 | 22.71 | 403.4 | 903.0 | 23.15 | 9.32 | 15.65 | 1167 | 3.24 | 8117 |
| | 100 | 23.74 | 459.7 | 982.0 | 23.96 | 9.72 | 15.94 | 1157 | 3.00 | 8164 |
| | 110 | 25.82 | 577.8 | 1145.9 | 25.52 | 10.57 | 16.57 | 1145 | 2.62 | 8368 |
| | 120 | 27.91 | 699.9 | 1313.9 | 26.98 | 11.25 | 17.05 | 1144 | 2.31 | 8644 |
| | 130 | 29.99 | 826.4 | 1486.2 | 28.36 | 11.80 | 17.42 | 1150 | 2.08 | 8961 |
| | 140 | 32.07 | 956.0 | 1661.6 | 29.66 | 12.20 | 17.67 | 1161 | 1.88 | 9310 |
| | 150 | 34.14 | 1087.6 | 1838.7 | 30.89 | 12.44 | 17.77 | 1177 | 1.72 | 9700 |
| | 160 | 36.20 | 1219.8 | 2016.3 | 32.03 | 12.56 | 17.75 | 1195 | 1.58 | 10100 |
| | 170 | 38.25 | 1351.7 | 2193.2 | 33.10 | 12.57 | 17.65 | 1215 | 1.47 | 10513 |
| | 180 | 40.28 | 1482.6 | 2368.7 | 34.11 | 12.50 | 17.47 | 1236 | 1.36 | 10937 |
| | 190 | 42.30 | 1611.8 | 2542.3 | 35.04 | 12.38 | 17.26 | 1258 | 1.28 | 11362 |
| | 200 | 44.30 | 1739.0 | 2713.6 | 35.92 | 12.23 | 17.03 | 1281 | 1.20 | 11785 |
| | 220 | 48.27 | 1987.1 | 3049.1 | 37.52 | 11.89 | 16.54 | 1326 | 1.07 | 12639 |
| | 240 | 52.20 | 2226.7 | 3375.1 | 38.94 | 11.57 | 16.09 | 1370 | 0.97 | 13485 |
| | 260 | 56.08 | 2459.0 | 3692.9 | 40.21 | 11.29 | 15.72 | 1412 | 0.88 | 14328 |
| | 280 | 59.93 | 2685.2 | 4003.8 | 41.37 | 11.06 | 15.41 | 1453 | 0.81 | 15157 |
| | 300 | 63.76 | 2906.5 | 4309.1 | 42.42 | 10.88 | 15.16 | 1493 | 0.75 | 15992 |

* TWO PHASE BOUNDARY

TABLE VI. THERMODYNAMIC PROPERTIES OF PARAHYDROGEN

240 BAR ISOBAR

| | TEMPERATURE K | MOLAR VOLUME $CM^3/G$ | INTERNAL ENERGY J/G | ENTHALPY J/G | ENTROPY J/G-K | SPECIFIC HEAT CV J/G-K | SPECIFIC HEAT CP J/G-K | VELOCITY OF SOUND M/S | $\left(\frac{\partial P}{\partial T}\right)_V$ BAR/K | $\left(\frac{\partial P}{\partial \rho}\right)_T$ BAR-$CM^3$/G |
|---|---|---|---|---|---|---|---|---|---|---|
| * | 20.300 | 11.52 | -285.9 | -9.4 | 5.44 | 5.47 | 6.87 | 1743 | 11.23 | 24184 |
| | 21 | 11.56 | -282.1 | -4.5 | 5.67 | 5.56 | 7.04 | 1739 | 11.23 | 23867 |
| | 22 | 11.63 | -276.4 | 2.6 | 6.00 | 5.68 | 7.28 | 1732 | 11.22 | 23412 |
| | 23 | 11.69 | -270.6 | 10.0 | 6.33 | 5.80 | 7.51 | 1725 | 11.20 | 22956 |
| | 24 | 11.76 | -264.6 | 17.6 | 6.66 | 5.90 | 7.74 | 1718 | 11.16 | 22498 |
| | 25 | 11.83 | -258.4 | 25.5 | 6.98 | 6.00 | 7.96 | 1710 | 11.11 | 22040 |
| | 26 | 11.90 | -252.1 | 33.6 | 7.30 | 6.09 | 8.18 | 1702 | 11.06 | 21583 |
| | 27 | 11.98 | -245.6 | 41.8 | 7.61 | 6.19 | 8.39 | 1694 | 10.99 | 21129 |
| | 28 | 12.05 | -238.9 | 50.3 | 7.92 | 6.26 | 8.60 | 1686 | 10.91 | 20678 |
| | 29 | 12.13 | -232.0 | 59.0 | 8.22 | 6.34 | 8.81 | 1677 | 10.83 | 20232 |
| | 30 | 12.21 | -225.0 | 68.0 | 8.52 | 6.40 | 9.01 | 1669 | 10.74 | 19793 |
| | 31 | 12.29 | -217.9 | 77.1 | 8.82 | 6.47 | 9.21 | 1660 | 10.64 | 19361 |
| | 32 | 12.37 | -210.6 | 86.4 | 9.12 | 6.53 | 9.41 | 1651 | 10.54 | 18938 |
| | 33 | 12.46 | -203.2 | 95.9 | 9.41 | 6.59 | 9.59 | 1642 | 10.42 | 18528 |
| | 34 | 12.55 | -195.6 | 105.6 | 9.70 | 6.64 | 9.77 | 1633 | 10.29 | 18138 |
| | 35 | 12.64 | -187.9 | 115.5 | 9.99 | 6.69 | 9.94 | 1624 | 10.16 | 17748 |
| | 36 | 12.73 | -180.1 | 125.5 | 10.27 | 6.73 | 10.11 | 1614 | 10.02 | 17352 |
| | 37 | 12.83 | -172.2 | 135.7 | 10.55 | 6.77 | 10.27 | 1605 | 9.88 | 16989 |
| | 38 | 12.92 | -164.2 | 146.0 | 10.82 | 6.81 | 10.43 | 1596 | 9.74 | 16622 |
| | 39 | 13.02 | -156.0 | 156.5 | 11.10 | 6.84 | 10.59 | 1586 | 9.60 | 16242 |
| | 40 | 13.12 | -147.8 | 167.2 | 11.37 | 6.86 | 10.75 | 1575 | 9.45 | 15848 |
| | 42 | 13.33 | -131.1 | 189.0 | 11.90 | 6.91 | 11.02 | 1558 | 9.15 | 15208 |
| | 44 | 13.55 | -114.0 | 211.3 | 12.42 | 6.95 | 11.29 | 1540 | 8.85 | 14604 |
| | 46 | 13.78 | -97.1 | 233.6 | 12.91 | 7.03 | 11.58 | 1520 | 8.55 | 14026 |
| | 48 | 14.02 | -79.3 | 257.1 | 13.41 | 7.10 | 11.85 | 1500 | 8.25 | 13476 |
| | 50 | 14.26 | -61.3 | 281.0 | 13.90 | 7.15 | 12.10 | 1482 | 7.95 | 12987 |
| | 55 | 14.91 | -14.9 | 342.9 | 15.08 | 7.23 | 12.64 | 1438 | 7.23 | 11905 |
| | 60 | 15.61 | 32.9 | 407.5 | 16.21 | 7.38 | 13.09 | 1398 | 6.56 | 11017 |
| | 65 | 16.36 | 81.4 | 473.9 | 17.27 | 7.52 | 13.48 | 1359 | 5.94 | 10315 |
| | 70 | 17.15 | 130.7 | 542.2 | 18.28 | 7.71 | 13.84 | 1325 | 5.40 | 9788 |
| | 75 | 17.98 | 180.9 | 612.3 | 19.25 | 7.96 | 14.20 | 1295 | 4.92 | 9403 |
| | 80 | 18.84 | 232.1 | 684.2 | 20.18 | 8.26 | 14.55 | 1268 | 4.50 | 9127 |
| | 85 | 19.72 | 284.4 | 757.8 | 21.07 | 8.60 | 14.90 | 1246 | 4.13 | 8957 |
| | 90 | 20.63 | 338.0 | 833.1 | 21.93 | 8.97 | 15.23 | 1227 | 3.81 | 8861 |
| | 95 | 21.55 | 392.9 | 910.1 | 22.76 | 9.36 | 15.56 | 1211 | 3.52 | 8824 |
| | 100 | 22.48 | 449.1 | 988.8 | 23.57 | 9.76 | 15.88 | 1199 | 3.27 | 8837 |
| | 110 | 24.37 | 567.5 | 1152.3 | 25.13 | 10.61 | 16.55 | 1183 | 2.86 | 8973 |
| | 120 | 26.26 | 690.0 | 1320.3 | 26.59 | 11.29 | 17.05 | 1179 | 2.53 | 9204 |
| | 130 | 28.16 | 816.8 | 1492.6 | 27.97 | 11.84 | 17.43 | 1182 | 2.27 | 9493 |
| | 140 | 30.05 | 946.8 | 1668.1 | 29.27 | 12.23 | 17.68 | 1191 | 2.06 | 9815 |
| | 150 | 31.94 | 1078.8 | 1845.4 | 30.49 | 12.47 | 17.80 | 1205 | 1.88 | 10169 |
| | 160 | 33.83 | 1211.5 | 2023.4 | 31.64 | 12.58 | 17.79 | 1221 | 1.73 | 10550 |
| | 170 | 35.70 | 1343.9 | 2200.7 | 32.71 | 12.60 | 17.69 | 1240 | 1.60 | 10944 |
| | 180 | 37.56 | 1475.2 | 2376.7 | 33.72 | 12.53 | 17.52 | 1260 | 1.49 | 11360 |
| | 190 | 39.41 | 1604.9 | 2550.8 | 34.66 | 12.41 | 17.31 | 1281 | 1.40 | 11776 |
| | 200 | 41.25 | 1732.6 | 2722.6 | 35.54 | 12.26 | 17.07 | 1303 | 1.31 | 12195 |
| | 220 | 44.89 | 1981.5 | 3059.0 | 37.15 | 11.93 | 16.59 | 1346 | 1.17 | 13034 |
| | 240 | 48.50 | 2222.0 | 3386.0 | 38.57 | 11.60 | 16.14 | 1389 | 1.06 | 13875 |
| | 260 | 52.06 | 2455.1 | 3704.6 | 39.84 | 11.32 | 15.76 | 1431 | 0.96 | 14708 |
| | 280 | 55.59 | 2682.1 | 4016.3 | 41.00 | 11.09 | 15.45 | 1471 | 0.88 | 15538 |
| | 300 | 59.10 | 2904.2 | 4322.5 | 42.06 | 10.92 | 15.20 | 1509 | 0.82 | 16350 |

* TWO PHASE BOUNDARY

TABLE VI. THERMODYNAMIC PROPERTIES OF PARAHYDROGEN

| TEMPERATURE K | MOLAR VOLUME $CM^3/G$ | INTERNAL ENERGY J/G | ENTHALPY J/G | ENTROPY J/G-K | SPECIFIC HEAT CV J/G-K | SPECIFIC HEAT CP J/G-K | VELOCITY OF SOUND M/S | $\left(\frac{\partial P}{\partial T}\right)_V$ BAR/K | $\left(\frac{\partial P}{\partial \rho}\right)_T$ BAR-$CM^3/G$ |
|---|---|---|---|---|---|---|---|---|---|
| 260 BAR ISOBAR | | | | | | | | | |
| * 20.756 | 11.44 | -283.2 | 14.2 | 5.47 | 5.51 | 6.91 | 1773 | 11.37 | 25074 |
| 21 | 11.45 | -281.9 | 15.9 | 5.55 | 5.54 | 6.97 | 1772 | 11.37 | 24967 |
| 22 | 11.52 | -276.4 | 23.0 | 5.88 | 5.67 | 7.20 | 1766 | 11.37 | 24523 |
| 23 | 11.58 | -270.7 | 30.3 | 6.20 | 5.78 | 7.43 | 1759 | 11.35 | 24076 |
| 24 | 11.64 | -264.8 | 37.8 | 6.52 | 5.89 | 7.65 | 1752 | 11.32 | 23628 |
| 25 | 11.71 | -258.8 | 45.6 | 6.84 | 5.99 | 7.87 | 1745 | 11.28 | 23179 |
| 26 | 11.78 | -252.F | 53.6 | 7.15 | 6.03 | 8.08 | 1738 | 11.23 | 22729 |
| 27 | 11.84 | -246.2 | 61.8 | 7.46 | 6.17 | 8.29 | 1730 | 11.16 | 22281 |
| 28 | 11.92 | -239.7 | 70.1 | 7.77 | 6.25 | 8.49 | 1722 | 11.09 | 21836 |
| 29 | 11.99 | -233.0 | 78.7 | 8.07 | 6.33 | 8.69 | 1714 | 11.02 | 21394 |
| 30 | 12.06 | -226.1 | 87.5 | 8.37 | 6.40 | 8.89 | 1706 | 10.93 | 20956 |
| 31 | 12.14 | -219.1 | 96.5 | 8.66 | 6.47 | 9.08 | 1698 | 10.84 | 20525 |
| 32 | 12.22 | -212.0 | 105.7 | 8.95 | 6.53 | 9.27 | 1689 | 10.74 | 20101 |
| 33 | 12.30 | -204.7 | 115.1 | 9.24 | 6.59 | 9.46 | 1681 | 10.64 | 19686 |
| 34 | 12.38 | -197.3 | 124.6 | 9.53 | 6.64 | 9.64 | 1672 | 10.52 | 19281 |
| 35 | 12.47 | -189.8 | 134.4 | 9.81 | 6.69 | 9.80 | 1664 | 10.39 | 18906 |
| 36 | 12.56 | -182.2 | 144.3 | 10.09 | 6.74 | 9.96 | 1655 | 10.26 | 18535 |
| 37 | 12.64 | -174.4 | 154.3 | 10.36 | 6.78 | 10.12 | 1647 | 10.13 | 18162 |
| 38 | 12.73 | -166.6 | 164.5 | 10.64 | 6.82 | 10.28 | 1638 | 10.00 | 17796 |
| 39 | 12.83 | -158.6 | 174.9 | 10.90 | 6.85 | 10.42 | 1629 | 9.86 | 17446 |
| 40 | 12.92 | -150.6 | 185.3 | 11.17 | 6.87 | 10.56 | 1621 | 9.72 | 17095 |
| 42 | 13.11 | -134.2 | 206.7 | 11.69 | 6.92 | 10.85 | 1601 | 9.43 | 16350 |
| 44 | 13.31 | -117.5 | 228.7 | 12.20 | 6.97 | 11.12 | 1584 | 9.14 | 15741 |
| 46 | 13.52 | -100.9 | 250.7 | 12.69 | 7.06 | 11.40 | 1565 | 8.85 | 15172 |
| 48 | 13.74 | -83.5 | 273.7 | 13.18 | 7.12 | 11.65 | 1547 | 8.55 | 14627 |
| 50 | 13.97 | -65.8 | 297.3 | 13.66 | 7.18 | 11.90 | 1529 | 8.26 | 14115 |
| 55 | 14.56 | -20.4 | 358.2 | 14.82 | 7.31 | 12.43 | 1487 | 7.55 | 13000 |
| 60 | 15.20 | 26.6 | 421.7 | 15.93 | 7.42 | 12.87 | 1448 | 6.89 | 12078 |
| 65 | 15.88 | 74.3 | 487.1 | 16.98 | 7.56 | 13.27 | 1411 | 6.28 | 11338 |
| 70 | 16.59 | 122.9 | 554.4 | 17.97 | 7.75 | 13.65 | 1375 | 5.73 | 10742 |
| 75 | 17.34 | 172.6 | 623.5 | 18.93 | 8.00 | 14.01 | 1344 | 5.24 | 10314 |
| 80 | 18.12 | 223.3 | 694.5 | 19.84 | 8.30 | 14.39 | 1316 | 4.81 | 9977 |
| 85 | 18.93 | 275.3 | 767.4 | 20.73 | 8.64 | 14.76 | 1292 | 4.43 | 9760 |
| 90 | 19.75 | 328.7 | 842.1 | 21.58 | 9.01 | 15.13 | 1271 | 4.10 | 9622 |
| 95 | 20.58 | 383.4 | 918.6 | 22.41 | 9.40 | 15.48 | 1254 | 3.80 | 9549 |
| 100 | 21.43 | 439.7 | 996.9 | 23.21 | 9.79 | 15.82 | 1240 | 3.54 | 9523 |
| 110 | 23.15 | 558.1 | 1160.1 | 24.76 | 10.65 | 16.53 | 1220 | 3.09 | 9595 |
| 120 | 24.89 | 680.8 | 1327.9 | 26.22 | 11.33 | 17.05 | 1213 | 2.74 | 9782 |
| 130 | 26.62 | 808.0 | 1500.2 | 27.60 | 11.87 | 17.43 | 1215 | 2.46 | 10043 |
| 140 | 28.36 | 938.4 | 1675.8 | 28.90 | 12.26 | 17.69 | 1221 | 2.23 | 10329 |
| 150 | 30.10 | 1070.7 | 1853.2 | 30.13 | 12.50 | 17.82 | 1232 | 2.04 | 10655 |
| 160 | 31.83 | 1203.7 | 2031.3 | 31.28 | 12.61 | 17.82 | 1247 | 1.88 | 11018 |
| 170 | 33.56 | 1336.5 | 2209.0 | 32.36 | 12.62 | 17.73 | 1265 | 1.74 | 11395 |
| 180 | 35.27 | 1468.2 | 2385.3 | 33.36 | 12.56 | 17.56 | 1284 | 1.62 | 11796 |
| 190 | 36.98 | 1598.3 | 2559.8 | 34.31 | 12.44 | 17.35 | 1304 | 1.52 | 12198 |
| 200 | 38.68 | 1726.4 | 2732.0 | 35.19 | 12.29 | 17.12 | 1325 | 1.43 | 12610 |
| 220 | 42.04 | 1976.2 | 3069.3 | 36.80 | 11.96 | 16.63 | 1367 | 1.27 | 13440 |
| 240 | 45.37 | 2217.5 | 3397.1 | 38.22 | 11.63 | 16.18 | 1409 | 1.15 | 14266 |
| 260 | 48.66 | 2451.4 | 3716.6 | 39.50 | 11.35 | 15.80 | 1450 | 1.04 | 15098 |
| 280 | 51.92 | 2679.1 | 4029.0 | 40.66 | 11.12 | 15.49 | 1489 | 0.96 | 15920 |
| 300 | 55.16 | 2901.9 | 4336.1 | 41.72 | 10.95 | 15.24 | 1526 | 0.89 | 16739 |

* TWO PHASE BOUNDARY

TABLE VI. THERMODYNAMIC PROPERTIES OF PARAHYDROGEN

| | 280 BAR ISOBAR TEMPERATURE K | MOLAR VOLUME $CM^3/G$ | INTERNAL ENERGY J/G | ENTHALPY J/G | ENTROPY J/G-K | SPECIFIC HEAT CV J/G-K | SPECIFIC HEAT CP J/G-K | VELOCITY OF SOUND M/S | $\left(\frac{\partial P}{\partial T}\right)_V$ BAR/K | $\left(\frac{\partial P}{\partial \rho}\right)_T$ BAR-$CM^3$/G |
|---|---|---|---|---|---|---|---|---|---|---|
| * | 21.205 | 11.36 | -280.5 | 37.7 | 5.50 | 5.55 | 6.95 | 1802 | 11.51 | 25952 |
| | 22 | 11.41 | -276.2 | 43.3 | 5.76 | 5.65 | 7.13 | 1798 | 11.51 | 25607 |
| | 23 | 11.47 | -270.6 | 50.5 | 6.08 | 5.76 | 7.35 | 1792 | 11.50 | 25171 |
| | 24 | 11.53 | -264.9 | 58.0 | 6.40 | 5.87 | 7.57 | 1785 | 11.47 | 24732 |
| | 25 | 11.59 | -259.0 | 65.7 | 6.71 | 5.97 | 7.78 | 1779 | 11.43 | 24291 |
| | 26 | 11.66 | -252.9 | 73.5 | 7.02 | 6.07 | 7.99 | 1772 | 11.39 | 23849 |
| | 27 | 11.72 | -246.6 | 81.6 | 7.33 | 6.16 | 8.19 | 1765 | 11.33 | 23408 |
| | 28 | 11.79 | -240.2 | 89.9 | 7.63 | 6.24 | 8.39 | 1757 | 11.27 | 22968 |
| | 29 | 11.86 | -233.6 | 98.4 | 7.93 | 6.32 | 8.59 | 1749 | 11.19 | 22530 |
| | 30 | 11.93 | -226.9 | 107.1 | 8.22 | 6.39 | 8.78 | 1742 | 11.11 | 22096 |
| | 31 | 12.00 | -220.1 | 116.0 | 8.51 | 6.46 | 8.97 | 1734 | 11.02 | 21666 |
| | 32 | 12.08 | -213.1 | 125.0 | 8.80 | 6.53 | 9.15 | 1726 | 10.93 | 21243 |
| | 33 | 12.15 | -206.0 | 134.3 | 9.08 | 6.59 | 9.34 | 1718 | 10.83 | 20826 |
| | 34 | 12.23 | -198.7 | 143.7 | 9.36 | 6.64 | 9.51 | 1709 | 10.73 | 20418 |
| | 35 | 12.31 | -191.4 | 153.3 | 9.64 | 6.70 | 9.68 | 1701 | 10.62 | 20019 |
| | 36 | 12.39 | -183.9 | 163.1 | 9.92 | 6.75 | 9.85 | 1693 | 10.51 | 19631 |
| | 37 | 12.47 | -176.3 | 173.0 | 10.19 | 6.79 | 9.99 | 1685 | 10.36 | 19293 |
| | 38 | 12.56 | -168.6 | 183.1 | 10.46 | 6.83 | 10.14 | 1677 | 10.23 | 18937 |
| | 39 | 12.65 | -160.8 | 193.3 | 10.72 | 6.86 | 10.28 | 1669 | 10.10 | 18582 |
| | 40 | 12.73 | -152.9 | 203.7 | 10.99 | 6.89 | 10.42 | 1661 | 9.97 | 18245 |
| | 42 | 12.91 | -136.8 | 224.8 | 11.50 | 6.94 | 10.68 | 1645 | 9.69 | 17572 |
| | 44 | 13.10 | -120.4 | 246.4 | 12.00 | 6.99 | 10.96 | 1626 | 9.41 | 16858 |
| | 46 | 13.30 | -104.2 | 268.1 | 12.49 | 7.09 | 11.24 | 1608 | 9.13 | 16274 |
| | 48 | 13.50 | -87.1 | 290.8 | 12.97 | 7.14 | 11.49 | 1591 | 8.84 | 15738 |
| | 50 | 13.71 | -69.8 | 314.0 | 13.44 | 7.21 | 11.72 | 1574 | 8.56 | 15222 |
| | 55 | 14.25 | -25.1 | 374.0 | 14.59 | 7.34 | 12.25 | 1532 | 7.86 | 14060 |
| | 60 | 14.84 | 21.1 | 436.6 | 15.68 | 7.45 | 12.69 | 1494 | 7.21 | 13110 |
| | 65 | 15.46 | 68.1 | 501.1 | 16.71 | 7.60 | 13.09 | 1458 | 6.61 | 12345 |
| | 70 | 16.12 | 116.1 | 567.5 | 17.69 | 7.79 | 13.47 | 1424 | 6.05 | 11722 |
| | 75 | 16.80 | 165.3 | 635.7 | 18.63 | 8.04 | 13.85 | 1391 | 5.55 | 11231 |
| | 80 | 17.51 | 215.6 | 706.0 | 19.54 | 8.33 | 14.24 | 1362 | 5.11 | 10849 |
| | 85 | 18.25 | 267.2 | 778.1 | 20.42 | 8.67 | 14.64 | 1336 | 4.72 | 10577 |
| | 90 | 19.00 | 320.3 | 852.3 | 21.26 | 9.04 | 15.02 | 1314 | 4.37 | 10396 |
| | 95 | 19.76 | 374.9 | 928.3 | 22.08 | 9.43 | 15.40 | 1295 | 4.07 | 10285 |
| | 100 | 20.54 | 431.1 | 1006.2 | 22.88 | 9.83 | 15.75 | 1280 | 3.79 | 10231 |
| | 110 | 22.12 | 549.5 | 1168.9 | 24.43 | 10.68 | 16.50 | 1257 | 3.33 | 10238 |
| | 120 | 23.71 | 672.4 | 1336.4 | 25.89 | 11.35 | 17.04 | 1248 | 2.95 | 10379 |
| | 130 | 25.32 | 799.8 | 1508.7 | 27.27 | 11.90 | 17.43 | 1247 | 2.65 | 10608 |
| | 140 | 26.92 | 930.5 | 1684.3 | 28.57 | 12.29 | 17.70 | 1251 | 2.41 | 10868 |
| | 150 | 28.52 | 1063.1 | 1861.8 | 29.80 | 12.53 | 17.82 | 1261 | 2.20 | 11172 |
| | 160 | 30.13 | 1196.5 | 2040.0 | 30.95 | 12.64 | 17.84 | 1274 | 2.03 | 11498 |
| | 170 | 31.72 | 1329.6 | 2217.8 | 32.02 | 12.65 | 17.75 | 1290 | 1.88 | 11861 |
| | 180 | 33.32 | 1461.6 | 2394.5 | 33.03 | 12.59 | 17.59 | 1308 | 1.75 | 12235 |
| | 190 | 34.90 | 1592.1 | 2569.3 | 33.98 | 12.47 | 17.39 | 1327 | 1.64 | 12636 |
| | 200 | 36.48 | 1720.6 | 2741.9 | 34.86 | 12.32 | 17.16 | 1347 | 1.54 | 13034 |
| | 220 | 39.60 | 1971.1 | 3080.0 | 36.47 | 11.99 | 16.67 | 1388 | 1.37 | 13853 |
| | 240 | 42.69 | 2213.2 | 3408.6 | 37.90 | 11.66 | 16.22 | 1429 | 1.24 | 14674 |
| | 260 | 45.75 | 2447.8 | 3728.8 | 39.19 | 11.38 | 15.84 | 1468 | 1.13 | 15491 |
| | 280 | 48.78 | 2676.3 | 4042.1 | 40.35 | 11.16 | 15.52 | 1506 | 1.03 | 16309 |
| | 300 | 51.78 | 2899.8 | 4349.6 | 41.41 | 10.98 | 15.27 | 1543 | 0.96 | 17120 |

* TWO PHASE BOUNDARY

TABLE VI. THERMODYNAMIC PROPERTIES OF PARAHYDROGEN

| | 300 BAR ISOBAR TEMPERATURE K | MOLAR VOLUME $CM^3/G$ | INTERNAL ENERGY J/G | ENTHALPY J/G | ENTROPY J/G-K | SPECIFIC HEAT CV J/G-K | SPECIFIC HEAT CP J/G-K | VELOCITY OF SOUND M/S | $\left(\frac{\partial P}{\partial T}\right)_V$ BAR/K | $\left(\frac{\partial P}{\partial \rho}\right)_T$ BAR-$CM^3$/G |
|---|---|---|---|---|---|---|---|---|---|---|
| * | 21.645 | 11.29 | -277.8 | 61.0 | 5.53 | 5.59 | 6.98 | 1831 | 11.65 | 26818 |
| | 22 | 11.31 | -275.9 | 63.5 | 5.64 | 5.63 | 7.06 | 1829 | 11.65 | 26668 |
| | 23 | 11.37 | -270.4 | 70.6 | 5.96 | 5.75 | 7.28 | 1823 | 11.64 | 26241 |
| | 24 | 11.43 | -264.8 | 78.0 | 6.28 | 5.86 | 7.50 | 1817 | 11.62 | 25811 |
| | 25 | 11.49 | -258.9 | 85.6 | 6.59 | 5.96 | 7.71 | 1811 | 11.59 | 25379 |
| | 26 | 11.55 | -253.0 | 93.4 | 6.89 | 6.06 | 7.91 | 1805 | 11.54 | 24945 |
| | 27 | 11.61 | -246.8 | 101.5 | 7.20 | 6.15 | 8.11 | 1798 | 11.49 | 24511 |
| | 28 | 11.67 | -240.5 | 109.7 | 7.50 | 6.23 | 8.30 | 1791 | 11.43 | 24077 |
| | 29 | 11.74 | -234.1 | 118.1 | 7.79 | 6.32 | 8.50 | 1783 | 11.36 | 23644 |
| | 30 | 11.81 | -227.5 | 126.7 | 8.08 | 6.39 | 8.68 | 1776 | 11.28 | 23213 |
| | 31 | 11.87 | -220.8 | 135.4 | 8.37 | 6.46 | 8.87 | 1768 | 11.20 | 22786 |
| | 32 | 11.94 | -213.9 | 144.4 | 8.65 | 6.53 | 9.05 | 1761 | 11.11 | 22364 |
| | 33 | 12.02 | -207.0 | 153.5 | 8.93 | 6.59 | 9.22 | 1753 | 11.02 | 21947 |
| | 34 | 12.09 | -199.8 | 162.8 | 9.21 | 6.65 | 9.40 | 1745 | 10.92 | 21537 |
| | 35 | 12.16 | -192.6 | 172.3 | 9.49 | 6.70 | 9.57 | 1737 | 10.82 | 21135 |
| | 36 | 12.24 | -185.3 | 182.0 | 9.76 | 6.75 | 9.73 | 1729 | 10.71 | 20742 |
| | 37 | 12.32 | -177.8 | 191.8 | 10.03 | 6.79 | 9.89 | 1721 | 10.60 | 20359 |
| | 38 | 12.40 | -170.2 | 201.7 | 10.29 | 6.84 | 10.05 | 1714 | 10.48 | 19988 |
| | 39 | 12.48 | -162.5 | 211.9 | 10.56 | 6.87 | 10.16 | 1706 | 10.33 | 19686 |
| | 40 | 12.56 | -154.8 | 222.1 | 10.82 | 6.90 | 10.29 | 1699 | 10.20 | 19330 |
| | 42 | 12.73 | -139.0 | 242.9 | 11.32 | 6.95 | 10.55 | 1684 | 9.94 | 18697 |
| | 44 | 12.91 | -122.9 | 264.3 | 11.82 | 7.01 | 10.80 | 1668 | 9.67 | 18050 |
| | 46 | 13.09 | -107.0 | 285.6 | 12.29 | 7.10 | 11.10 | 1648 | 9.39 | 17371 |
| | 48 | 13.28 | -90.2 | 308.1 | 12.77 | 7.17 | 11.35 | 1631 | 9.11 | 16808 |
| | 50 | 13.47 | -73.1 | 331.0 | 13.24 | 7.23 | 11.57 | 1615 | 8.83 | 16302 |
| | 55 | 13.98 | -29.2 | 390.2 | 14.37 | 7.37 | 12.09 | 1575 | 8.15 | 15115 |
| | 60 | 14.52 | 16.3 | 452.0 | 15.44 | 7.49 | 12.52 | 1538 | 7.50 | 14141 |
| | 65 | 15.10 | 62.7 | 515.6 | 16.46 | 7.63 | 12.93 | 1503 | 6.91 | 13326 |
| | 70 | 15.70 | 110.2 | 581.3 | 17.43 | 7.82 | 13.31 | 1470 | 6.35 | 12695 |
| | 75 | 16.33 | 158.8 | 648.8 | 18.37 | 8.07 | 13.71 | 1436 | 5.85 | 12142 |
| | 80 | 16.99 | 208.7 | 718.3 | 19.26 | 8.37 | 14.10 | 1406 | 5.40 | 11745 |
| | 85 | 17.66 | 260.0 | 789.8 | 20.13 | 8.71 | 14.51 | 1379 | 5.00 | 11413 |
| | 90 | 18.35 | 312.9 | 863.4 | 20.97 | 9.08 | 14.92 | 1355 | 4.64 | 11183 |
| | 95 | 19.06 | 367.3 | 938.9 | 21.79 | 9.47 | 15.31 | 1336 | 4.32 | 11034 |
| | 100 | 19.77 | 423.3 | 1016.5 | 22.58 | 9.86 | 15.69 | 1319 | 4.04 | 10947 |
| | 110 | 21.23 | 541.7 | 1178.6 | 24.13 | 10.71 | 16.46 | 1294 | 3.55 | 10898 |
| | 120 | 22.71 | 664.7 | 1345.9 | 25.58 | 11.33 | 17.01 | 1282 | 3.16 | 10998 |
| | 130 | 24.19 | 792.3 | 1518.0 | 26.96 | 11.93 | 17.42 | 1278 | 2.84 | 11188 |
| | 140 | 25.68 | 923.1 | 1693.6 | 28.26 | 12.31 | 17.69 | 1281 | 2.58 | 11426 |
| | 150 | 27.17 | 1056.0 | 1871.1 | 29.49 | 12.55 | 17.83 | 1289 | 2.36 | 11703 |
| | 160 | 28.66 | 1189.7 | 2049.4 | 30.64 | 12.66 | 17.84 | 1301 | 2.18 | 12009 |
| | 170 | 30.14 | 1323.1 | 2227.4 | 31.72 | 12.68 | 17.77 | 1315 | 2.02 | 12337 |
| | 180 | 31.62 | 1455.4 | 2404.2 | 32.73 | 12.61 | 17.62 | 1332 | 1.88 | 12700 |
| | 190 | 33.10 | 1586.2 | 2579.3 | 33.67 | 12.50 | 17.42 | 1350 | 1.76 | 13071 |
| | 200 | 34.57 | 1715.1 | 2752.3 | 34.56 | 12.35 | 17.19 | 1369 | 1.65 | 13472 |
| | 220 | 37.49 | 1966.3 | 3091.0 | 36.17 | 12.01 | 16.71 | 1409 | 1.47 | 14271 |
| | 240 | 40.37 | 2209.1 | 3420.3 | 37.61 | 11.69 | 16.26 | 1448 | 1.33 | 15079 |
| | 260 | 43.23 | 2444.4 | 3741.3 | 38.89 | 11.41 | 15.87 | 1487 | 1.21 | 15888 |
| | 280 | 46.06 | 2673.6 | 4055.2 | 40.06 | 11.19 | 15.56 | 1524 | 1.11 | 16703 |
| | 300 | 48.86 | 2897.7 | 4363.5 | 41.12 | 11.01 | 15.30 | 1560 | 1.02 | 17509 |

* TWO PHASE BOUNDARY

TABLE VI. THERMODYNAMIC PROPERTIES OF PARAHYDROGEN

| 320 BAR ISOBAR TEMPERATURE K | MOLAR VOLUME $CM^3/G$ | INTERNAL ENERGY J/G | ENTHALPY J/G | ENTROPY J/G-K | SPECIFIC HEAT CV J/G-K | SPECIFIC HEAT CP J/G-K | VELOCITY OF SOUND M/S | $\left(\frac{\partial P}{\partial T}\right)_V$ BAR/K | $\left(\frac{\partial P}{\partial \rho}\right)_T$ BAR-$CM^3/G$ |
|---|---|---|---|---|---|---|---|---|---|
| * 22.078 | 11.22 | -275.0 | 84.1 | 5.56 | 5.63 | 7.02 | 1858 | 11.79 | 27673 |
| 23 | 11.27 | -270.0 | 90.7 | 5.85 | 5.73 | 7.22 | 1854 | 11.78 | 27289 |
| 24 | 11.33 | -264.5 | 98.0 | 6.16 | 5.85 | 7.43 | 1848 | 11.77 | 26869 |
| 25 | 11.38 | -258.7 | 105.6 | 6.47 | 5.95 | 7.64 | 1842 | 11.74 | 26445 |
| 26 | 11.44 | -252.9 | 113.3 | 6.77 | 6.05 | 7.83 | 1836 | 11.69 | 26019 |
| 27 | 11.50 | -246.8 | 121.2 | 7.07 | 6.14 | 8.03 | 1830 | 11.65 | 25592 |
| 28 | 11.56 | -240.7 | 129.4 | 7.37 | 6.23 | 8.22 | 1823 | 11.59 | 25164 |
| 29 | 11.63 | -234.3 | 137.7 | 7.66 | 6.31 | 8.41 | 1816 | 11.52 | 24736 |
| 30 | 11.69 | -227.9 | 146.2 | 7.95 | 6.38 | 8.59 | 1809 | 11.45 | 24310 |
| 31 | 11.75 | -221.3 | 154.9 | 8.23 | 6.46 | 8.77 | 1802 | 11.37 | 23887 |
| 32 | 11.82 | -214.5 | 163.7 | 8.52 | 6.52 | 8.95 | 1794 | 11.29 | 23466 |
| 33 | 11.89 | -207.7 | 172.8 | 8.79 | 6.59 | 9.12 | 1787 | 11.20 | 23050 |
| 34 | 11.96 | -200.7 | 182.0 | 9.07 | 6.64 | 9.29 | 1779 | 11.10 | 22640 |
| 35 | 12.03 | -193.6 | 191.4 | 9.34 | 6.70 | 9.46 | 1771 | 11.00 | 22236 |
| 36 | 12.10 | -186.4 | 200.9 | 9.61 | 6.75 | 9.62 | 1764 | 10.90 | 21840 |
| 37 | 12.18 | -179.0 | 210.6 | 9.87 | 6.80 | 9.78 | 1756 | 10.79 | 21452 |
| 38 | 12.25 | -171.6 | 220.4 | 10.14 | 6.84 | 9.93 | 1749 | 10.68 | 21074 |
| 39 | 12.33 | -164.0 | 230.4 | 10.40 | 6.87 | 10.07 | 1741 | 10.57 | 20707 |
| 40 | 12.41 | -156.4 | 240.6 | 10.65 | 6.91 | 10.18 | 1734 | 10.42 | 20411 |
| 42 | 12.57 | -140.9 | 261.2 | 11.16 | 6.96 | 10.43 | 1720 | 10.16 | 19739 |
| 44 | 12.73 | -125.1 | 282.3 | 11.65 | 7.02 | 10.67 | 1706 | 9.91 | 19153 |
| 46 | 12.90 | -109.4 | 303.4 | 12.12 | 7.11 | 10.95 | 1689 | 9.64 | 18529 |
| 48 | 13.08 | -92.9 | 325.5 | 12.59 | 7.18 | 11.21 | 1671 | 9.37 | 17888 |
| 50 | 13.26 | -76.1 | 348.2 | 13.05 | 7.25 | 11.44 | 1654 | 9.10 | 17341 |
| 55 | 13.73 | -32.8 | 406.7 | 14.16 | 7.40 | 11.95 | 1617 | 8.42 | 16179 |
| 60 | 14.24 | 12.1 | 467.3 | 15.23 | 7.51 | 12.33 | 1579 | 7.78 | 15141 |
| 65 | 14.78 | 57.9 | 530.7 | 16.23 | 7.66 | 12.78 | 1545 | 7.19 | 14310 |
| 70 | 15.34 | 104.8 | 595.6 | 17.20 | 7.86 | 13.19 | 1511 | 6.64 | 13609 |
| 75 | 15.92 | 153.0 | 662.5 | 18.12 | 8.11 | 13.57 | 1480 | 6.13 | 13084 |
| 80 | 16.52 | 202.6 | 731.4 | 19.01 | 8.40 | 13.98 | 1448 | 5.67 | 12612 |
| 85 | 17.15 | 253.6 | 802.3 | 19.87 | 8.74 | 14.40 | 1420 | 5.26 | 12252 |
| 90 | 17.79 | 306.1 | 875.3 | 20.70 | 9.11 | 14.82 | 1395 | 4.90 | 11977 |
| 95 | 18.44 | 360.4 | 950.5 | 21.51 | 9.50 | 15.23 | 1374 | 4.57 | 11789 |
| 100 | 19.11 | 416.2 | 1027.6 | 22.31 | 9.90 | 15.62 | 1357 | 4.28 | 11665 |
| 110 | 20.46 | 534.5 | 1189.1 | 23.84 | 10.75 | 16.41 | 1330 | 3.77 | 11580 |
| 120 | 21.83 | 657.5 | 1356.1 | 25.30 | 11.42 | 16.99 | 1315 | 3.37 | 11626 |
| 130 | 23.21 | 785.2 | 1528.1 | 26.67 | 11.96 | 17.42 | 1309 | 3.03 | 11770 |
| 140 | 24.60 | 916.3 | 1703.6 | 27.97 | 12.34 | 17.69 | 1311 | 2.75 | 11996 |
| 150 | 25.99 | 1049.4 | 1881.1 | 29.20 | 12.53 | 17.82 | 1317 | 2.52 | 12249 |
| 160 | 27.38 | 1183.3 | 2059.4 | 30.35 | 12.69 | 17.85 | 1328 | 2.32 | 12533 |
| 170 | 28.77 | 1316.9 | 2237.4 | 31.43 | 12.70 | 17.78 | 1341 | 2.15 | 12843 |
| 180 | 30.15 | 1449.6 | 2414.5 | 32.44 | 12.64 | 17.64 | 1356 | 2.01 | 13171 |
| 190 | 31.53 | 1580.7 | 2589.7 | 33.39 | 12.52 | 17.44 | 1373 | 1.88 | 13535 |
| 200 | 32.91 | 1709.8 | 2762.9 | 34.28 | 12.37 | 17.22 | 1391 | 1.76 | 13912 |
| 220 | 35.64 | 1961.7 | 3102.3 | 35.89 | 12.04 | 16.74 | 1429 | 1.57 | 14691 |
| 240 | 38.35 | 2205.2 | 3432.3 | 37.33 | 11.72 | 16.29 | 1468 | 1.42 | 15497 |
| 260 | 41.02 | 2441.2 | 3754.0 | 38.62 | 11.44 | 15.91 | 1505 | 1.29 | 16301 |
| 280 | 43.68 | 2671.0 | 4068.6 | 39.78 | 11.22 | 15.59 | 1542 | 1.18 | 17101 |
| 300 | 46.30 | 2895.8 | 4377.5 | 40.85 | 11.04 | 15.34 | 1577 | 1.09 | 17903 |

* TWO PHASE BOUNDARY

TABLE VI. THERMODYNAMIC PROPERTIES OF PARAHYDROGEN

| | 340 BAR ISOBAR TEMPERATURE K | MOLAR VOLUME $CM^3/G$ | INTERNAL ENERGY J/G | ENTHALPY J/G | ENTROPY J/G-K | SPECIFIC HEAT CV J/G-K | SPECIFIC HEAT CP J/G-K | VELOCITY OF SOUND M/S | $\left(\frac{\partial P}{\partial T}\right)_V$ BAR/K | $\left(\frac{\partial P}{\partial \rho}\right)_T$ BAR-$CM^3$/G |
|---|---|---|---|---|---|---|---|---|---|---|
| * | 22.504 | 11.16 | -272.1 | 107.2 | 5.59 | 5.66 | 7.06 | 1885 | 11.93 | 28519 |
| | 23 | 11.18 | -269.5 | 110.7 | 5.74 | 5.72 | 7.16 | 1883 | 11.92 | 28317 |
| | 24 | 11.24 | -264.0 | 118.0 | 6.05 | 5.83 | 7.37 | 1878 | 11.91 | 27906 |
| | 25 | 11.29 | -258.4 | 125.4 | 6.36 | 5.94 | 7.57 | 1873 | 11.88 | 27491 |
| | 26 | 11.35 | -252.6 | 133.1 | 6.66 | 6.03 | 7.77 | 1867 | 11.84 | 27073 |
| | 27 | 11.40 | -246.7 | 141.0 | 6.96 | 6.13 | 7.96 | 1861 | 11.80 | 26652 |
| | 28 | 11.46 | -240.6 | 149.0 | 7.25 | 6.22 | 8.15 | 1854 | 11.74 | 26231 |
| | 29 | 11.52 | -234.4 | 157.3 | 7.54 | 6.30 | 8.34 | 1848 | 11.68 | 25809 |
| | 30 | 11.58 | -228.0 | 165.7 | 7.82 | 6.38 | 8.51 | 1841 | 11.61 | 25388 |
| | 31 | 11.64 | -221.6 | 174.3 | 8.11 | 6.45 | 8.69 | 1834 | 11.53 | 24968 |
| | 32 | 11.71 | -214.9 | 183.1 | 8.38 | 6.52 | 8.86 | 1827 | 11.45 | 24550 |
| | 33 | 11.77 | -208.2 | 192.0 | 8.66 | 6.58 | 9.03 | 1819 | 11.37 | 24136 |
| | 34 | 11.84 | -201.3 | 201.1 | 8.93 | 6.64 | 9.20 | 1812 | 11.27 | 23726 |
| | 35 | 11.90 | -194.3 | 210.4 | 9.20 | 6.70 | 9.36 | 1805 | 11.18 | 23322 |
| | 36 | 11.97 | -187.2 | 219.8 | 9.47 | 6.75 | 9.52 | 1797 | 11.08 | 22924 |
| | 37 | 12.04 | -180.0 | 229.4 | 9.73 | 6.80 | 9.67 | 1790 | 10.98 | 22533 |
| | 38 | 12.11 | -172.7 | 239.2 | 9.99 | 6.85 | 9.82 | 1782 | 10.87 | 22150 |
| | 39 | 12.19 | -165.3 | 249.1 | 10.25 | 6.88 | 9.96 | 1775 | 10.76 | 21777 |
| | 40 | 12.26 | -157.7 | 259.1 | 10.50 | 6.91 | 10.10 | 1768 | 10.65 | 21414 |
| | 42 | 12.41 | -142.5 | 279.5 | 11.00 | 6.97 | 10.32 | 1755 | 10.38 | 20803 |
| | 44 | 12.57 | -126.9 | 300.4 | 11.48 | 7.03 | 10.57 | 1740 | 10.13 | 20153 |
| | 46 | 12.73 | -111.5 | 321.3 | 11.95 | 7.13 | 10.83 | 1726 | 9.87 | 19611 |
| | 48 | 12.89 | -95.2 | 343.2 | 12.41 | 7.20 | 11.08 | 1710 | 9.61 | 19009 |
| | 50 | 13.06 | -78.6 | 365.6 | 12.87 | 7.27 | 11.32 | 1693 | 9.35 | 18408 |
| | 55 | 13.51 | -35.9 | 423.5 | 13.97 | 7.42 | 11.82 | 1656 | 8.69 | 17207 |
| | 60 | 13.99 | 8.4 | 483.9 | 15.03 | 7.54 | 12.25 | 1620 | 8.05 | 16154 |
| | 65 | 14.49 | 53.6 | 546.2 | 16.02 | 7.69 | 12.66 | 1585 | 7.46 | 15272 |
| | 70 | 15.01 | 100.1 | 610.5 | 16.98 | 7.93 | 13.06 | 1552 | 6.91 | 14556 |
| | 75 | 15.56 | 147.9 | 676.8 | 17.89 | 8.14 | 13.45 | 1521 | 6.40 | 14005 |
| | 80 | 16.12 | 197.1 | 745.1 | 18.77 | 8.44 | 13.86 | 1490 | 5.94 | 13520 |
| | 85 | 16.70 | 247.8 | 815.4 | 19.62 | 8.78 | 14.29 | 1461 | 5.52 | 13101 |
| | 90 | 17.29 | 300.1 | 887.9 | 20.45 | 9.15 | 14.72 | 1435 | 5.15 | 12800 |
| | 95 | 17.90 | 354.1 | 962.6 | 21.26 | 9.54 | 15.15 | 1413 | 4.81 | 12564 |
| | 100 | 18.52 | 409.8 | 1039.4 | 22.05 | 9.93 | 15.55 | 1394 | 4.51 | 12407 |
| | 110 | 19.78 | 527.9 | 1200.3 | 23.58 | 10.78 | 16.36 | 1364 | 3.99 | 12261 |
| | 120 | 21.06 | 650.9 | 1367.0 | 25.03 | 11.45 | 16.96 | 1348 | 3.56 | 12263 |
| | 130 | 22.35 | 778.7 | 1539.8 | 26.41 | 11.98 | 17.40 | 1340 | 3.21 | 12372 |
| | 140 | 23.65 | 910.6 | 1714.2 | 27.70 | 12.37 | 17.69 | 1340 | 2.92 | 12553 |
| | 150 | 24.95 | 1043.3 | 1891.7 | 28.93 | 12.60 | 17.83 | 1345 | 2.67 | 12796 |
| | 160 | 26.26 | 1177.4 | 2070.0 | 30.08 | 12.72 | 17.85 | 1354 | 2.47 | 13067 |
| | 170 | 27.55 | 1311.2 | 2249.1 | 31.16 | 12.73 | 17.78 | 1366 | 2.29 | 13358 |
| | 180 | 28.85 | 1444.1 | 2425.1 | 32.17 | 12.65 | 17.65 | 1380 | 2.13 | 13671 |
| | 190 | 30.15 | 1575.4 | 2600.6 | 33.12 | 12.55 | 17.46 | 1396 | 2.00 | 14002 |
| | 200 | 31.45 | 1704.9 | 2774.0 | 34.01 | 12.40 | 17.24 | 1413 | 1.88 | 14367 |
| | 220 | 34.02 | 1957.4 | 3113.9 | 35.63 | 12.07 | 16.77 | 1450 | 1.67 | 15134 |
| | 240 | 36.56 | 2201.5 | 3444.6 | 37.07 | 11.74 | 16.32 | 1488 | 1.51 | 15920 |
| | 260 | 39.08 | 2438.1 | 3766.9 | 38.36 | 11.47 | 15.94 | 1524 | 1.37 | 16716 |
| | 280 | 41.58 | 2668.5 | 4082.2 | 39.53 | 11.25 | 15.62 | 1560 | 1.26 | 17512 |
| | 300 | 44.05 | 2894.0 | 4391.7 | 40.60 | 11.07 | 15.37 | 1594 | 1.16 | 18301 |

* TWO PHASE BOUNDARY

TABLE VI. THERMODYNAMIC PROPERTIES OF PARAHYDROGEN

| | 360 BAR ISOBAR TEMPERATURE K | MOLAR VOLUME $CM^3/G$ | INTERNAL ENERGY J/G | ENTHALPY J/G | ENTROPY J/G-K | SPECIFIC HEAT CV J/G-K | SPECIFIC HEAT CP J/G-K | VELOCITY OF SOUND M/S | $\left(\frac{\partial P}{\partial T}\right)_V$ BAR/K | $\left(\frac{\partial P}{\partial \rho}\right)_T$ BAR-$CM^3$/G |
|---|---|---|---|---|---|---|---|---|---|---|
| * | 22.924 | 11.09 | -259.3 | 130.1 | 5.62 | 5.70 | 7.09 | 1912 | 12.06 | 29356 |
| | 23 | 11.10 | -258.9 | 130.6 | 5.64 | 5.70 | 7.11 | 1912 | 12.06 | 29326 |
| | 24 | 11.15 | -253.5 | 137.8 | 5.95 | 5.82 | 7.32 | 1907 | 12.05 | 28924 |
| | 25 | 11.20 | -248.0 | 145.2 | 6.25 | 5.92 | 7.51 | 1902 | 12.02 | 28517 |
| | 26 | 11.25 | -242.3 | 152.8 | 6.55 | 6.02 | 7.71 | 1896 | 11.99 | 28107 |
| | 27 | 11.31 | -246.4 | 160.6 | 6.84 | 6.12 | 7.90 | 1890 | 11.94 | 27694 |
| | 28 | 11.36 | -240.4 | 168.6 | 7.13 | 6.21 | 8.08 | 1884 | 11.89 | 27279 |
| | 29 | 11.42 | -234.3 | 176.8 | 7.42 | 6.29 | 8.27 | 1878 | 11.83 | 26863 |
| | 30 | 11.48 | -228.1 | 185.2 | 7.70 | 6.37 | 8.44 | 1872 | 11.76 | 26447 |
| | 31 | 11.54 | -221.7 | 193.7 | 7.98 | 6.45 | 8.61 | 1865 | 11.69 | 26031 |
| | 32 | 11.60 | -215.1 | 202.4 | 8.26 | 6.52 | 8.78 | 1858 | 11.61 | 25617 |
| | 33 | 11.66 | -208.5 | 211.2 | 8.53 | 6.58 | 8.95 | 1851 | 11.53 | 25206 |
| | 34 | 11.72 | -201.7 | 220.3 | 8.80 | 6.64 | 9.11 | 1844 | 11.44 | 24797 |
| | 35 | 11.79 | -194.8 | 229.5 | 9.07 | 6.70 | 9.27 | 1837 | 11.35 | 24393 |
| | 36 | 11.85 | -187.8 | 238.8 | 9.33 | 6.75 | 9.42 | 1829 | 11.25 | 23994 |
| | 37 | 11.92 | -180.7 | 248.3 | 9.59 | 6.80 | 9.57 | 1822 | 11.15 | 23601 |
| | 38 | 11.99 | -173.5 | 257.9 | 9.85 | 6.85 | 9.72 | 1815 | 11.05 | 23215 |
| | 39 | 12.05 | -166.2 | 267.7 | 10.10 | 6.89 | 9.86 | 1808 | 10.94 | 22837 |
| | 40 | 12.12 | -158.8 | 277.7 | 10.35 | 6.92 | 9.99 | 1801 | 10.83 | 22468 |
| | 42 | 12.27 | -143.8 | 297.9 | 10.85 | 6.98 | 10.25 | 1787 | 10.61 | 21760 |
| | 44 | 12.42 | -128.4 | 318.6 | 11.33 | 7.05 | 10.46 | 1774 | 10.34 | 21201 |
| | 46 | 12.57 | -113.2 | 339.3 | 11.79 | 7.14 | 10.73 | 1759 | 10.09 | 20570 |
| | 48 | 12.73 | -97.2 | 361.0 | 12.25 | 7.22 | 10.96 | 1746 | 9.84 | 20070 |
| | 50 | 12.89 | -80.8 | 383.1 | 12.70 | 7.29 | 11.20 | 1730 | 9.58 | 19488 |
| | 55 | 13.31 | -38.7 | 440.4 | 13.79 | 7.44 | 11.71 | 1692 | 8.93 | 18199 |
| | 60 | 13.76 | 5.1 | 500.3 | 14.84 | 7.57 | 12.13 | 1659 | 8.30 | 17163 |
| | 65 | 14.22 | 49.9 | 562.0 | 15.82 | 7.72 | 12.54 | 1623 | 7.71 | 16225 |
| | 70 | 14.72 | 95.9 | 625.7 | 16.77 | 7.92 | 12.95 | 1591 | 7.16 | 15478 |
| | 75 | 15.23 | 143.3 | 691.5 | 17.68 | 8.17 | 13.36 | 1559 | 6.66 | 14866 |
| | 80 | 15.75 | 192.2 | 759.3 | 18.55 | 8.47 | 13.76 | 1529 | 6.19 | 14388 |
| | 85 | 16.29 | 242.5 | 829.1 | 19.40 | 8.81 | 14.20 | 1499 | 5.77 | 13950 |
| | 90 | 16.85 | 294.6 | 901.2 | 20.22 | 9.18 | 14.62 | 1474 | 5.39 | 13648 |
| | 95 | 17.42 | 348.4 | 975.4 | 21.02 | 9.57 | 15.07 | 1449 | 5.05 | 13341 |
| | 100 | 17.99 | 403.9 | 1051.7 | 21.81 | 9.95 | 15.48 | 1430 | 4.74 | 13155 |
| | 110 | 19.18 | 521.8 | 1212.2 | 23.33 | 10.81 | 16.32 | 1398 | 4.20 | 12945 |
| | 120 | 20.38 | 644.8 | 1378.4 | 24.78 | 11.49 | 16.93 | 1380 | 3.76 | 12911 |
| | 130 | 21.59 | 772.7 | 1550.0 | 26.15 | 12.01 | 17.39 | 1371 | 3.39 | 12980 |
| | 140 | 22.81 | 904.1 | 1725.3 | 27.45 | 12.40 | 17.68 | 1369 | 3.09 | 13142 |
| | 150 | 24.04 | 1037.5 | 1902.9 | 28.68 | 12.63 | 17.82 | 1373 | 2.83 | 13355 |
| | 160 | 25.26 | 1171.8 | 2081.2 | 29.83 | 12.74 | 17.85 | 1381 | 2.61 | 13605 |
| | 170 | 26.48 | 1305.8 | 2259.3 | 30.91 | 12.75 | 17.78 | 1391 | 2.42 | 13883 |
| | 180 | 27.71 | 1438.9 | 2436.4 | 31.92 | 12.68 | 17.65 | 1404 | 2.26 | 14175 |
| | 190 | 28.93 | 1570.5 | 2611.9 | 32.87 | 12.57 | 17.47 | 1419 | 2.11 | 14496 |
| | 200 | 30.15 | 1700.1 | 2785.5 | 33.76 | 12.42 | 17.26 | 1435 | 1.99 | 14829 |
| | 220 | 32.57 | 1953.2 | 3125.8 | 35.38 | 12.09 | 16.80 | 1471 | 1.77 | 15569 |
| | 240 | 34.98 | 2197.9 | 3457.1 | 36.82 | 11.77 | 16.35 | 1507 | 1.60 | 16349 |
| | 260 | 37.36 | 2435.1 | 3779.9 | 38.12 | 11.49 | 15.97 | 1543 | 1.45 | 17132 |
| | 280 | 39.71 | 2666.2 | 4095.8 | 39.29 | 11.27 | 15.65 | 1577 | 1.33 | 17908 |
| | 300 | 42.05 | 2892.2 | 4406.0 | 40.36 | 11.10 | 15.39 | 1611 | 1.23 | 18711 |

* TWO PHASE BOUNDARY

TABLE VI. THERMODYNAMIC PROPERTIES OF PARAHYDROGEN

| | 380 BAR ISOBAR TEMPERATURE K | MOLAR VOLUME $CM^3/G$ | INTERNAL ENERGY J/G | ENTHALPY J/G | ENTROPY J/G-K | SPECIFIC HEAT CV J/G-K | SPECIFIC HEAT CP J/G-K | VELOCITY OF SOUND M/S | $\left(\frac{\partial P}{\partial T}\right)_V$ BAR/K | $\left(\frac{\partial P}{\partial \rho}\right)_T$ BAR-$CM^3/G$ |
|---|---|---|---|---|---|---|---|---|---|---|
| * | 23.338 | 11.03 | -266.3 | 152.8 | 5.64 | 5.73 | 7.13 | 1938 | 12.20 | 30185 |
| | 24 | 11.06 | -262.8 | 157.6 | 5.85 | 5.80 | 7.26 | 1935 | 12.19 | 29924 |
| | 25 | 11.11 | -257.4 | 164.9 | 6.15 | 5.91 | 7.46 | 1930 | 12.17 | 29526 |
| | 26 | 11.16 | -251.8 | 172.5 | 6.44 | 6.01 | 7.65 | 1925 | 12.13 | 29124 |
| | 27 | 11.22 | -246.0 | 180.2 | 6.73 | 6.11 | 7.84 | 1919 | 12.09 | 28718 |
| | 28 | 11.27 | -240.1 | 188.2 | 7.02 | 6.20 | 8.02 | 1914 | 12.04 | 28310 |
| | 29 | 11.33 | -234.1 | 196.3 | 7.31 | 6.29 | 8.20 | 1907 | 11.98 | 27900 |
| | 30 | 11.38 | -227.9 | 204.6 | 7.59 | 6.37 | 8.37 | 1901 | 11.91 | 27489 |
| | 31 | 11.44 | -221.6 | 213.0 | 7.87 | 6.44 | 8.54 | 1895 | 11.84 | 27078 |
| | 32 | 11.50 | -215.2 | 221.7 | 8.14 | 6.51 | 8.71 | 1888 | 11.77 | 26668 |
| | 33 | 11.55 | -208.6 | 230.4 | 8.41 | 6.58 | 8.87 | 1881 | 11.69 | 26259 |
| | 34 | 11.61 | -202.1 | 239.4 | 8.68 | 6.64 | 9.03 | 1875 | 11.60 | 25853 |
| | 35 | 11.68 | -195.2 | 248.5 | 8.94 | 6.70 | 9.18 | 1868 | 11.51 | 25450 |
| | 36 | 11.74 | -188.3 | 257.8 | 9.20 | 6.76 | 9.34 | 1861 | 11.42 | 25051 |
| | 37 | 11.80 | -181.3 | 267.2 | 9.46 | 6.81 | 9.48 | 1853 | 11.32 | 24657 |
| | 38 | 11.87 | -174.2 | 276.7 | 9.72 | 6.85 | 9.63 | 1846 | 11.22 | 24269 |
| | 39 | 11.93 | -167.0 | 286.4 | 9.97 | 6.89 | 9.76 | 1840 | 11.12 | 23888 |
| | 40 | 12.00 | -159.7 | 296.3 | 10.22 | 6.93 | 9.89 | 1833 | 11.01 | 23515 |
| | 42 | 12.14 | -144.8 | 316.3 | 10.70 | 6.99 | 10.15 | 1819 | 10.79 | 22794 |
| | 44 | 12.28 | -129.7 | 336.9 | 11.18 | 7.05 | 10.40 | 1805 | 10.56 | 22114 |
| | 46 | 12.42 | -114.7 | 357.3 | 11.64 | 7.15 | 10.63 | 1792 | 10.29 | 21604 |
| | 48 | 12.57 | -98.8 | 378.4 | 12.10 | 7.23 | 10.88 | 1777 | 10.05 | 20992 |
| | 50 | 12.72 | -82.7 | 400.8 | 12.54 | 7.30 | 11.09 | 1766 | 9.80 | 20531 |
| | 55 | 13.12 | -41.1 | 457.6 | 13.63 | 7.46 | 11.61 | 1729 | 9.17 | 19225 |
| | 60 | 13.54 | 2.3 | 516.9 | 14.66 | 7.59 | 12.02 | 1695 | 8.55 | 18145 |
| | 65 | 13.99 | 46.6 | 578.1 | 15.64 | 7.75 | 12.43 | 1661 | 7.96 | 17204 |
| | 70 | 14.45 | 92.2 | 641.3 | 16.57 | 7.95 | 12.84 | 1627 | 7.41 | 16394 |
| | 75 | 14.93 | 139.2 | 706.5 | 17.47 | 8.20 | 13.26 | 1596 | 6.90 | 15751 |
| | 80 | 15.43 | 187.7 | 773.9 | 18.34 | 8.50 | 13.68 | 1566 | 6.44 | 15233 |
| | 85 | 15.93 | 237.8 | 843.3 | 19.19 | 8.84 | 14.10 | 1538 | 6.01 | 14833 |
| | 90 | 16.45 | 289.6 | 914.9 | 20.00 | 9.21 | 14.55 | 1510 | 5.62 | 14438 |
| | 95 | 16.99 | 343.2 | 988.7 | 20.80 | 9.60 | 14.97 | 1487 | 5.27 | 14175 |
| | 100 | 17.53 | 398.6 | 1064.7 | 21.58 | 9.99 | 15.41 | 1465 | 4.95 | 13911 |
| | 110 | 18.64 | 516.3 | 1224.5 | 23.10 | 10.84 | 16.27 | 1431 | 4.41 | 13644 |
| | 120 | 19.77 | 639.2 | 1390.4 | 24.55 | 11.51 | 16.90 | 1411 | 3.95 | 13564 |
| | 130 | 20.91 | 767.1 | 1561.8 | 25.92 | 12.04 | 17.37 | 1401 | 3.57 | 13601 |
| | 140 | 22.06 | 898.5 | 1737.0 | 27.22 | 12.42 | 17.68 | 1397 | 3.25 | 13714 |
| | 150 | 23.22 | 1032.1 | 1914.4 | 28.44 | 12.66 | 17.83 | 1399 | 2.98 | 13909 |
| | 160 | 24.37 | 1166.6 | 2092.8 | 29.59 | 12.77 | 17.85 | 1407 | 2.75 | 14155 |
| | 170 | 25.53 | 1300.8 | 2270.8 | 30.67 | 12.77 | 17.79 | 1416 | 2.55 | 14401 |
| | 180 | 26.68 | 1434.1 | 2448.0 | 31.68 | 12.71 | 17.65 | 1429 | 2.38 | 14694 |
| | 190 | 27.84 | 1565.8 | 2623.6 | 32.63 | 12.59 | 17.48 | 1443 | 2.23 | 14992 |
| | 200 | 28.99 | 1695.7 | 2797.2 | 33.52 | 12.44 | 17.27 | 1458 | 2.10 | 15317 |
| | 220 | 31.28 | 1949.2 | 3138.0 | 35.15 | 12.11 | 16.82 | 1491 | 1.87 | 16020 |
| | 240 | 33.56 | 2194.4 | 3469.7 | 36.59 | 11.79 | 16.38 | 1527 | 1.69 | 16783 |
| | 260 | 35.81 | 2432.3 | 3793.2 | 37.89 | 11.52 | 16.00 | 1561 | 1.54 | 17557 |
| | 280 | 38.05 | 2663.9 | 4109.6 | 39.06 | 11.30 | 15.68 | 1595 | 1.41 | 18339 |
| | 300 | 40.26 | 2890.9 | 4420.3 | 40.13 | 11.13 | 15.43 | 1627 | 1.30 | 19107 |

* TWO PHASE BOUNDARY

TABLE VI. THERMODYNAMIC PROPERTIES OF PARAHYDROGEN

| | 400 BAR ISOBAR TEMPERATURE K | MOLAR VOLUME CM3/G | INTERNAL ENERGY J/G | ENTHALPY J/G | ENTROPY J/G-K | SPECIFIC HEAT CV J/G-K | SPECIFIC HEAT CP J/G-K | VELOCITY OF SOUND M/S | $\left(\frac{\partial P}{\partial T}\right)_V$ BAR/K | $\left(\frac{\partial P}{\partial \rho}\right)_T$ BAR-CM3/G |
|---|---|---|---|---|---|---|---|---|---|---|
| * | 23.746 | 10.97 | -263.4 | 175.4 | 5.67 | 5.76 | 7.16 | 1963 | 12.33 | 31006 |
| | 24 | 10.98 | -262.1 | 177.3 | 5.75 | 5.79 | 7.22 | 1962 | 12.33 | 30908 |
| | 25 | 11.03 | -256.7 | 184.6 | 6.05 | 5.90 | 7.41 | 1958 | 12.31 | 30519 |
| | 26 | 11.08 | -251.2 | 192.1 | 6.34 | 6.00 | 7.60 | 1953 | 12.27 | 30124 |
| | 27 | 11.13 | -245.5 | 199.8 | 6.63 | 6.10 | 7.78 | 1948 | 12.23 | 29726 |
| | 28 | 11.18 | -239.7 | 207.7 | 6.92 | 6.19 | 7.97 | 1942 | 12.18 | 29325 |
| | 29 | 11.24 | -233.7 | 215.7 | 7.20 | 6.28 | 8.14 | 1936 | 12.13 | 28921 |
| | 30 | 11.29 | -227.6 | 223.9 | 7.48 | 6.36 | 8.31 | 1930 | 12.06 | 28516 |
| | 31 | 11.34 | -221.4 | 232.3 | 7.75 | 6.44 | 8.48 | 1924 | 11.99 | 28110 |
| | 32 | 11.40 | -215.1 | 240.9 | 8.03 | 6.51 | 8.64 | 1918 | 11.92 | 27703 |
| | 33 | 11.46 | -208.6 | 249.6 | 8.29 | 6.58 | 8.80 | 1911 | 11.84 | 27298 |
| | 34 | 11.51 | -202.0 | 258.5 | 8.56 | 6.64 | 8.96 | 1904 | 11.76 | 26895 |
| | 35 | 11.57 | -195.3 | 267.5 | 8.82 | 6.70 | 9.11 | 1898 | 11.67 | 26493 |
| | 36 | 11.63 | -188.5 | 276.7 | 9.08 | 6.76 | 9.26 | 1891 | 11.58 | 26095 |
| | 37 | 11.69 | -181.6 | 286.0 | 9.34 | 6.81 | 9.40 | 1884 | 11.48 | 25701 |
| | 38 | 11.75 | -174.6 | 295.5 | 9.59 | 6.86 | 9.54 | 1877 | 11.38 | 25312 |
| | 39 | 11.82 | -167.5 | 305.1 | 9.84 | 6.90 | 9.68 | 1870 | 11.28 | 24929 |
| | 40 | 11.88 | -160.3 | 314.9 | 10.08 | 6.93 | 9.81 | 1864 | 11.18 | 24553 |
| | 42 | 12.01 | -145.7 | 334.7 | 10.57 | 7.00 | 10.06 | 1850 | 10.97 | 23822 |
| | 44 | 12.14 | -130.7 | 355.1 | 11.04 | 7.07 | 10.31 | 1837 | 10.75 | 23127 |
| | 46 | 12.28 | -115.9 | 375.4 | 11.49 | 7.16 | 10.58 | 1822 | 10.52 | 22474 |
| | 48 | 12.43 | -100.3 | 396.8 | 11.95 | 7.24 | 10.78 | 1810 | 10.25 | 22012 |
| | 50 | 12.57 | -84.3 | 418.5 | 12.39 | 7.32 | 11.01 | 1795 | 10.01 | 21416 |
| | 55 | 12.95 | -43.1 | 474.9 | 13.47 | 7.48 | 11.51 | 1763 | 9.40 | 20209 |
| | 60 | 13.35 | -0.3 | 533.7 | 14.49 | 7.61 | 11.93 | 1730 | 8.78 | 19094 |
| | 65 | 13.77 | 43.6 | 594.4 | 15.46 | 7.77 | 12.33 | 1697 | 8.20 | 18164 |
| | 70 | 14.21 | 88.9 | 657.1 | 16.39 | 7.98 | 12.75 | 1663 | 7.65 | 17310 |
| | 75 | 14.66 | 135.5 | 721.9 | 17.28 | 8.23 | 13.17 | 1631 | 7.14 | 16628 |
| | 80 | 15.13 | 183.7 | 788.8 | 18.15 | 8.53 | 13.60 | 1601 | 6.67 | 16076 |
| | 85 | 15.61 | 233.6 | 857.9 | 18.99 | 8.87 | 14.02 | 1574 | 6.24 | 15683 |
| | 90 | 16.10 | 285.1 | 929.1 | 19.80 | 9.24 | 14.45 | 1547 | 5.85 | 15301 |
| | 95 | 16.60 | 338.5 | 1002.5 | 20.59 | 9.63 | 14.92 | 1520 | 5.49 | 14916 |
| | 100 | 17.11 | 393.7 | 1078.1 | 21.37 | 10.02 | 15.35 | 1499 | 5.17 | 14677 |
| | 110 | 18.15 | 511.2 | 1237.3 | 22.88 | 10.87 | 16.23 | 1463 | 4.61 | 14338 |
| | 120 | 19.22 | 634.0 | 1402.8 | 24.32 | 11.54 | 16.87 | 1442 | 4.14 | 14218 |
| | 130 | 20.30 | 761.9 | 1573.9 | 25.69 | 12.07 | 17.35 | 1430 | 3.74 | 14223 |
| | 140 | 21.39 | 893.4 | 1749.0 | 26.99 | 12.45 | 17.66 | 1425 | 3.41 | 14313 |
| | 150 | 22.48 | 1027.1 | 1926.4 | 28.22 | 12.68 | 17.82 | 1426 | 3.13 | 14481 |
| | 160 | 23.58 | 1161.7 | 2104.7 | 29.37 | 12.79 | 17.85 | 1432 | 2.89 | 14694 |
| | 170 | 24.67 | 1296.1 | 2282.9 | 30.45 | 12.83 | 17.79 | 1441 | 2.68 | 14948 |
| | 180 | 25.76 | 1429.5 | 2460.0 | 31.46 | 12.73 | 17.66 | 1452 | 2.50 | 15207 |
| | 190 | 26.86 | 1561.4 | 2635.6 | 32.41 | 12.61 | 17.49 | 1465 | 2.35 | 15490 |
| | 200 | 27.95 | 1691.5 | 2809.3 | 33.30 | 12.47 | 17.28 | 1480 | 2.21 | 15806 |
| | 220 | 30.12 | 1945.4 | 3150.3 | 34.92 | 12.14 | 16.84 | 1512 | 1.97 | 16473 |
| | 240 | 32.28 | 2191.2 | 3482.5 | 36.37 | 11.82 | 16.41 | 1546 | 1.78 | 17214 |
| | 260 | 34.43 | 2429.5 | 3806.6 | 37.67 | 11.55 | 16.03 | 1580 | 1.62 | 17984 |
| | 280 | 36.55 | 2661.7 | 4123.6 | 38.84 | 11.33 | 15.71 | 1613 | 1.48 | 18762 |
| | 300 | 38.65 | 2898.9 | 4434.8 | 39.92 | 11.16 | 15.45 | 1644 | 1.37 | 19533 |

* TWO PHASE BOUNDARY

TABLE VI. THERMODYNAMIC PROPERTIES OF PARAHYDROGEN

| | 450 BAR ISOBAR TEMPERATURE K | MOLAR VOLUME $CM^3/G$ | INTERNAL ENERGY J/G | ENTHALPY J/G | ENTROPY J/G-K | SPECIFIC HEAT CV J/G-K | SPECIFIC HEAT CP J/G-K | VELOCITY OF SOUND M/S | $\left(\frac{\partial P}{\partial T}\right)_V$ BAR/K | $\left(\frac{\partial P}{\partial \rho}\right)_T$ BAR-$CM^3$/G |
|---|---|---|---|---|---|---|---|---|---|---|
| * | 24.742 | 10.83 | -255.9 | 231.5 | 5.74 | 5.84 | 7.25 | 2025 | 12.66 | 33029 |
| | 25 | 10.84 | -254.6 | 233.4 | 5.81 | 5.87 | 7.30 | 2023 | 12.66 | 32934 |
| | 26 | 10.89 | -249.2 | 240.8 | 6.10 | 5.98 | 7.49 | 2019 | 12.62 | 32559 |
| | 27 | 10.94 | -243.7 | 249.4 | 6.39 | 6.09 | 7.67 | 2015 | 12.58 | 32180 |
| | 28 | 10.98 | -238.1 | 256.1 | 6.67 | 6.17 | 7.84 | 2010 | 12.54 | 31796 |
| | 29 | 11.03 | -232.3 | 264.0 | 6.95 | 6.26 | 8.01 | 2004 | 12.48 | 31408 |
| | 30 | 11.08 | -226.4 | 272.1 | 7.22 | 6.35 | 8.18 | 1999 | 12.42 | 31017 |
| | 31 | 11.13 | -220.4 | 280.4 | 7.49 | 6.43 | 8.34 | 1993 | 12.35 | 30624 |
| | 32 | 11.18 | -214.2 | 288.8 | 7.76 | 6.50 | 8.50 | 1988 | 12.28 | 30230 |
| | 33 | 11.23 | -208.0 | 297.4 | 8.02 | 6.57 | 8.65 | 1982 | 12.21 | 29834 |
| | 34 | 11.28 | -201.6 | 306.1 | 8.28 | 6.64 | 8.80 | 1975 | 12.13 | 29439 |
| | 35 | 11.34 | -195.1 | 315.0 | 8.54 | 6.70 | 8.94 | 1969 | 12.04 | 29044 |
| | 36 | 11.39 | -188.5 | 324.0 | 8.79 | 6.76 | 9.09 | 1963 | 11.95 | 28651 |
| | 37 | 11.44 | -181.8 | 333.1 | 9.05 | 6.81 | 9.23 | 1956 | 11.86 | 28260 |
| | 38 | 11.50 | -175.0 | 342.4 | 9.29 | 6.86 | 9.36 | 1950 | 11.77 | 27872 |
| | 39 | 11.55 | -168.1 | 351.9 | 9.54 | 6.90 | 9.49 | 1943 | 11.68 | 27487 |
| | 40 | 11.61 | -161.1 | 361.4 | 9.78 | 6.94 | 9.61 | 1937 | 11.58 | 27106 |
| | 42 | 11.73 | -146.9 | 380.9 | 10.26 | 7.02 | 9.85 | 1924 | 11.38 | 26361 |
| | 44 | 11.85 | -132.4 | 400.8 | 10.72 | 7.09 | 10.09 | 1911 | 11.17 | 25642 |
| | 46 | 11.97 | -118.1 | 420.7 | 11.16 | 7.19 | 10.36 | 1896 | 10.95 | 24954 |
| | 48 | 12.10 | -102.8 | 441.7 | 11.61 | 7.29 | 10.61 | 1882 | 10.73 | 24301 |
| | 50 | 12.23 | -87.3 | 463.2 | 12.05 | 7.35 | 10.84 | 1868 | 10.50 | 23690 |
| | 55 | 12.57 | -47.2 | 518.4 | 13.10 | 7.53 | 11.31 | 1839 | 9.90 | 22490 |
| | 60 | 12.92 | -5.3 | 576.3 | 14.11 | 7.67 | 11.73 | 1811 | 9.32 | 21434 |
| | 65 | 13.29 | 37.7 | 635.9 | 15.06 | 7.83 | 12.13 | 1780 | 8.75 | 20458 |
| | 70 | 13.69 | 82.0 | 697.6 | 15.97 | 8.04 | 12.53 | 1749 | 8.20 | 19628 |
| | 75 | 14.08 | 127.8 | 761.3 | 16.85 | 8.30 | 12.96 | 1716 | 7.69 | 18872 |
| | 80 | 14.49 | 175.3 | 827.2 | 17.70 | 8.61 | 13.41 | 1684 | 7.22 | 18200 |
| | 85 | 14.91 | 224.5 | 895.4 | 18.53 | 8.95 | 13.86 | 1655 | 6.78 | 17674 |
| | 90 | 15.34 | 275.6 | 965.9 | 19.34 | 9.32 | 14.32 | 1627 | 6.38 | 17230 |
| | 95 | 15.78 | 328.5 | 1038.5 | 20.12 | 9.70 | 14.75 | 1604 | 6.01 | 16940 |
| | 100 | 16.22 | 383.3 | 1113.4 | 20.89 | 10.10 | 15.18 | 1582 | 5.67 | 16641 |
| | 110 | 17.13 | 500.1 | 1271.1 | 22.39 | 10.94 | 16.10 | 1542 | 5.08 | 16144 |
| | 120 | 18.07 | 622.6 | 1435.6 | 23.82 | 11.61 | 16.80 | 1515 | 4.59 | 15873 |
| | 130 | 19.02 | 750.4 | 1606.1 | 25.19 | 12.14 | 17.30 | 1500 | 4.16 | 15798 |
| | 140 | 19.97 | 882.0 | 1780.7 | 26.48 | 12.52 | 17.63 | 1493 | 3.81 | 15824 |
| | 150 | 20.93 | 1015.9 | 1957.9 | 27.70 | 12.75 | 17.80 | 1491 | 3.50 | 15924 |
| | 160 | 21.90 | 1150.7 | 2136.1 | 28.85 | 12.85 | 17.85 | 1494 | 3.24 | 16084 |
| | 170 | 22.86 | 1285.4 | 2314.3 | 29.93 | 12.86 | 17.79 | 1501 | 3.01 | 16289 |
| | 180 | 23.83 | 1419.2 | 2491.4 | 30.95 | 12.79 | 17.66 | 1510 | 2.81 | 16520 |
| | 190 | 24.79 | 1551.5 | 2667.2 | 31.89 | 12.67 | 17.49 | 1522 | 2.63 | 16785 |
| | 200 | 25.76 | 1682.0 | 2840.9 | 32.79 | 12.52 | 17.30 | 1535 | 2.48 | 17052 |
| | 220 | 27.68 | 1936.8 | 3182.3 | 34.41 | 12.19 | 16.87 | 1563 | 2.21 | 17656 |
| | 240 | 29.60 | 2183.5 | 3515.4 | 35.86 | 11.87 | 16.46 | 1594 | 2.00 | 18338 |
| | 260 | 31.50 | 2423.1 | 3840.6 | 37.16 | 11.61 | 16.09 | 1626 | 1.82 | 19074 |
| | 280 | 33.38 | 2656.6 | 4158.9 | 38.34 | 11.39 | 15.77 | 1657 | 1.67 | 19840 |
| | 300 | 35.25 | 2885.2 | 4471.6 | 39.42 | 11.22 | 15.52 | 1687 | 1.54 | 20592 |

* TWO PHASE BOUNDARY

TABLE VI. THERMODYNAMIC PROPERTIES OF PARAHYDROGEN

| | 500 BAR ISOBAR TEMPERATURE K | MOLAR VOLUME CM3/G | INTERNAL ENERGY J/G | ENTHALPY J/G | ENTROPY J/G-K | SPECIFIC HEAT CV J/G-K | SPECIFIC HEAT CP J/G-K | VELOCITY OF SOUND M/S | $\left(\frac{\partial P}{\partial T}\right)_V$ BAR/K | $\left(\frac{\partial P}{\partial \rho}\right)_T$ BAR-CM3/G |
|---|---|---|---|---|---|---|---|---|---|---|
| * | 25.708 | 10.70 | -248.3 | 286.9 | 5.80 | 5.92 | 7.34 | 2083 | 12.98 | 35015 |
| | 26 | 10.72 | -246.8 | 289.0 | 5.88 | 5.95 | 7.39 | 2082 | 12.97 | 34910 |
| | 27 | 10.76 | -241.4 | 296.5 | 6.16 | 6.06 | 7.57 | 2078 | 12.93 | 34549 |
| | 28 | 10.80 | -236.0 | 304.2 | 6.44 | 6.15 | 7.74 | 2073 | 12.88 | 34183 |
| | 29 | 10.85 | -230.4 | 312.0 | 6.71 | 6.25 | 7.91 | 2069 | 12.83 | 33811 |
| | 30 | 10.89 | -224.6 | 320.0 | 6.99 | 6.33 | 8.07 | 2064 | 12.77 | 33436 |
| | 31 | 10.94 | -218.8 | 328.1 | 7.25 | 6.41 | 8.22 | 2059 | 12.70 | 33057 |
| | 32 | 10.98 | -212.8 | 336.4 | 7.52 | 6.49 | 8.38 | 2053 | 12.63 | 32675 |
| | 33 | 11.03 | -206.7 | 344.9 | 7.78 | 6.56 | 8.53 | 2048 | 12.56 | 32291 |
| | 34 | 11.08 | -200.4 | 353.5 | 8.03 | 6.63 | 8.67 | 2042 | 12.48 | 31906 |
| | 35 | 11.13 | -194.1 | 362.2 | 8.29 | 6.70 | 8.81 | 2036 | 12.40 | 31520 |
| | 36 | 11.18 | -187.7 | 371.1 | 8.54 | 6.76 | 8.95 | 2030 | 12.31 | 31134 |
| | 37 | 11.23 | -181.2 | 380.1 | 8.78 | 6.82 | 9.08 | 2024 | 12.22 | 30748 |
| | 38 | 11.28 | -174.5 | 389.3 | 9.03 | 6.87 | 9.21 | 2018 | 12.13 | 30364 |
| | 39 | 11.33 | -167.8 | 398.5 | 9.27 | 6.91 | 9.33 | 2012 | 12.04 | 29981 |
| | 40 | 11.38 | -161.0 | 407.9 | 9.51 | 6.95 | 9.45 | 2006 | 11.95 | 29601 |
| | 42 | 11.48 | -147.2 | 427.0 | 9.97 | 7.03 | 9.68 | 1993 | 11.75 | 28852 |
| | 44 | 11.59 | -133.1 | 446.6 | 10.43 | 7.11 | 9.91 | 1980 | 11.55 | 28120 |
| | 46 | 11.71 | -119.1 | 466.2 | 10.86 | 7.22 | 10.18 | 1966 | 11.35 | 27411 |
| | 48 | 11.82 | -104.2 | 486.8 | 11.30 | 7.31 | 10.42 | 1952 | 11.13 | 26730 |
| | 50 | 11.94 | -89.1 | 507.9 | 11.73 | 7.39 | 10.65 | 1938 | 10.92 | 26080 |
| | 55 | 12.25 | -49.9 | 562.4 | 12.77 | 7.57 | 11.17 | 1906 | 10.37 | 24621 |
| | 60 | 12.56 | -8.9 | 619.3 | 13.76 | 7.72 | 11.57 | 1880 | 9.80 | 23579 |
| | 65 | 12.90 | 33.3 | 678.1 | 14.70 | 7.89 | 11.97 | 1854 | 9.25 | 22640 |
| | 70 | 13.24 | 76.9 | 739.0 | 15.60 | 8.10 | 12.37 | 1824 | 8.71 | 21801 |
| | 75 | 13.60 | 122.0 | 801.9 | 16.47 | 8.37 | 12.79 | 1794 | 8.20 | 21050 |
| | 80 | 13.96 | 168.9 | 867.0 | 17.31 | 8.67 | 13.24 | 1763 | 7.72 | 20363 |
| | 85 | 14.34 | 217.5 | 934.3 | 18.13 | 9.02 | 13.71 | 1732 | 7.28 | 19736 |
| | 90 | 14.72 | 268.1 | 1004.0 | 18.93 | 9.39 | 14.18 | 1703 | 6.87 | 19223 |
| | 95 | 15.11 | 320.6 | 1076.1 | 19.70 | 9.78 | 14.63 | 1678 | 6.49 | 18812 |
| | 100 | 15.51 | 375.0 | 1150.4 | 20.47 | 10.17 | 15.06 | 1657 | 6.14 | 18548 |
| | 110 | 16.31 | 491.2 | 1306.9 | 21.96 | 11.01 | 15.99 | 1615 | 5.53 | 17962 |
| | 120 | 17.14 | 613.3 | 1470.3 | 23.38 | 11.69 | 16.71 | 1586 | 5.01 | 17593 |
| | 130 | 17.98 | 740.8 | 1640.1 | 24.74 | 12.21 | 17.24 | 1568 | 4.57 | 17402 |
| | 140 | 18.84 | 872.4 | 1814.2 | 26.03 | 12.53 | 17.60 | 1557 | 4.18 | 17339 |
| | 150 | 19.70 | 1006.4 | 1991.1 | 27.25 | 12.81 | 17.78 | 1553 | 3.85 | 17387 |
| | 160 | 20.56 | 1141.4 | 2169.2 | 28.40 | 12.91 | 17.84 | 1554 | 3.57 | 17493 |
| | 170 | 21.42 | 1276.4 | 2347.3 | 29.48 | 12.92 | 17.79 | 1559 | 3.32 | 17643 |
| | 180 | 22.28 | 1410.4 | 2524.5 | 30.49 | 12.85 | 17.67 | 1566 | 3.10 | 17840 |
| | 190 | 23.14 | 1543.1 | 2700.2 | 31.44 | 12.73 | 17.50 | 1576 | 2.91 | 18065 |
| | 200 | 24.01 | 1673.8 | 2874.2 | 32.33 | 12.58 | 17.30 | 1588 | 2.74 | 18325 |
| | 220 | 25.73 | 1929.3 | 3215.7 | 33.96 | 12.24 | 16.89 | 1613 | 2.45 | 18867 |
| | 240 | 27.45 | 2176.8 | 3549.2 | 35.41 | 11.93 | 16.49 | 1641 | 2.22 | 19487 |
| | 260 | 29.16 | 2417.3 | 3875.3 | 36.72 | 11.66 | 16.14 | 1671 | 2.02 | 20173 |
| | 280 | 30.86 | 2652.0 | 4194.8 | 37.90 | 11.45 | 15.84 | 1701 | 1.86 | 20912 |
| | 300 | 32.54 | 2881.8 | 4508.7 | 38.98 | 11.29 | 15.58 | 1730 | 1.71 | 21669 |

* TWO PHASE BOUNDARY

TABLE VI. THERMODYNAMIC PROPERTIES OF PARAHYDROGEN

| | 550 BAR ISOBAR TEMPERATURE K | MOLAR VOLUME CM3/G | INTERNAL ENERGY J/G | ENTHALPY J/G | ENTROPY J/G-K | SPECIFIC HEAT CV J/G-K | SPECIFIC HEAT CP J/G-K | VELOCITY OF SOUND M/S | $\left(\frac{\partial P}{\partial T}\right)_V$ BAR/K | $\left(\frac{\partial P}{\partial \rho}\right)_T$ BAR-CM3/G |
|---|---|---|---|---|---|---|---|---|---|---|
| * | 26.646 | 10.58 | -240.6 | 341.6 | 5.85 | 6.00 | 7.43 | 2139 | 13.29 | 36968 |
| | 27 | 10.60 | -238.7 | 344.2 | 5.95 | 6.04 | 7.49 | 2138 | 13.28 | 36846 |
| | 28 | 10.64 | -233.4 | 351.8 | 6.23 | 6.14 | 7.66 | 2134 | 13.23 | 36497 |
| | 29 | 10.68 | -227.9 | 359.6 | 6.50 | 6.23 | 7.82 | 2129 | 13.17 | 36142 |
| | 30 | 10.72 | -222.3 | 367.5 | 6.77 | 6.32 | 7.98 | 2125 | 13.11 | 35782 |
| | 31 | 10.77 | -216.6 | 375.5 | 7.03 | 6.40 | 8.13 | 2120 | 13.04 | 35417 |
| | 32 | 10.81 | -210.7 | 383.7 | 7.29 | 6.48 | 8.28 | 2115 | 12.97 | 35049 |
| | 33 | 10.85 | -204.8 | 392.1 | 7.55 | 6.56 | 8.42 | 2110 | 12.90 | 34677 |
| | 34 | 10.90 | -198.7 | 400.6 | 7.80 | 6.63 | 8.56 | 2105 | 12.82 | 34303 |
| | 35 | 10.94 | -192.5 | 409.2 | 8.05 | 6.70 | 8.70 | 2099 | 12.74 | 33927 |
| | 36 | 10.99 | -186.3 | 418.0 | 8.30 | 6.76 | 8.83 | 2094 | 12.65 | 33549 |
| | 37 | 11.03 | -179.9 | 426.9 | 8.54 | 6.82 | 8.96 | 2088 | 12.57 | 33171 |
| | 38 | 11.08 | -173.4 | 435.9 | 8.78 | 6.87 | 9.09 | 2082 | 12.48 | 32793 |
| | 39 | 11.13 | -166.9 | 445.0 | 9.02 | 6.92 | 9.20 | 2076 | 12.39 | 32415 |
| | 40 | 11.17 | -160.2 | 454.3 | 9.26 | 6.96 | 9.32 | 2071 | 12.29 | 32039 |
| | 42 | 11.27 | -146.7 | 473.1 | 9.72 | 7.04 | 9.54 | 2059 | 12.10 | 31291 |
| | 44 | 11.37 | -132.9 | 492.4 | 10.16 | 7.12 | 9.76 | 2046 | 11.91 | 30556 |
| | 46 | 11.47 | -119.2 | 511.7 | 10.59 | 7.24 | 10.02 | 2032 | 11.71 | 29836 |
| | 48 | 11.58 | -104.7 | 532.0 | 11.02 | 7.33 | 10.25 | 2018 | 11.50 | 29137 |
| | 50 | 11.68 | -89.9 | 552.7 | 11.45 | 7.42 | 10.48 | 2005 | 11.30 | 28463 |
| | 55 | 11.96 | -51.5 | 606.4 | 12.47 | 7.61 | 11.00 | 1972 | 10.76 | 26909 |
| | 60 | 12.25 | -11.2 | 662.8 | 13.45 | 7.76 | 11.44 | 1942 | 10.22 | 25583 |
| | 65 | 12.56 | 30.2 | 720.7 | 14.38 | 7.94 | 11.83 | 1920 | 9.69 | 24756 |
| | 70 | 12.87 | 73.1 | 780.9 | 15.27 | 8.16 | 12.24 | 1893 | 9.17 | 23898 |
| | 75 | 13.19 | 117.7 | 843.2 | 16.13 | 8.43 | 12.65 | 1865 | 8.66 | 23176 |
| | 80 | 13.52 | 163.9 | 907.6 | 16.96 | 8.74 | 13.11 | 1835 | 8.19 | 22441 |
| | 85 | 13.86 | 212.1 | 974.3 | 17.77 | 9.08 | 13.57 | 1805 | 7.74 | 21805 |
| | 90 | 14.20 | 262.2 | 1043.3 | 18.56 | 9.46 | 14.05 | 1775 | 7.33 | 21221 |
| | 95 | 14.55 | 314.3 | 1114.8 | 19.33 | 9.85 | 14.52 | 1748 | 6.94 | 20739 |
| | 100 | 14.91 | 368.4 | 1188.5 | 20.09 | 10.24 | 14.97 | 1724 | 6.58 | 20338 |
| | 110 | 15.64 | 484.1 | 1344.2 | 21.57 | 11.03 | 15.88 | 1684 | 5.94 | 19788 |
| | 120 | 16.38 | 605.6 | 1505.6 | 22.98 | 11.75 | 16.62 | 1653 | 5.40 | 19312 |
| | 130 | 17.14 | 732.9 | 1675.5 | 24.33 | 12.27 | 17.18 | 1632 | 4.94 | 19017 |
| | 140 | 17.91 | 864.4 | 1849.2 | 25.62 | 12.65 | 17.56 | 1619 | 4.54 | 18886 |
| | 150 | 18.68 | 998.4 | 2025.8 | 26.84 | 12.87 | 17.76 | 1613 | 4.20 | 18860 |
| | 160 | 19.46 | 1133.5 | 2203.6 | 27.99 | 12.98 | 17.83 | 1612 | 3.89 | 18909 |
| | 170 | 20.24 | 1268.6 | 2381.7 | 29.07 | 12.98 | 17.78 | 1615 | 3.62 | 19026 |
| | 180 | 21.02 | 1402.9 | 2558.9 | 30.08 | 12.91 | 17.67 | 1620 | 3.39 | 19183 |
| | 190 | 21.80 | 1535.7 | 2734.6 | 31.03 | 12.79 | 17.50 | 1629 | 3.18 | 19378 |
| | 200 | 22.58 | 1666.8 | 2908.5 | 31.92 | 12.63 | 17.31 | 1638 | 3.00 | 19598 |
| | 220 | 24.14 | 1922.9 | 3250.3 | 33.55 | 12.30 | 16.89 | 1662 | 2.69 | 20097 |
| | 240 | 25.69 | 2171.0 | 3584.0 | 35.00 | 11.99 | 16.51 | 1687 | 2.43 | 20650 |
| | 260 | 27.24 | 2412.3 | 3910.5 | 36.31 | 11.71 | 16.18 | 1715 | 2.22 | 21282 |
| | 280 | 28.78 | 2647.7 | 4230.9 | 37.50 | 11.50 | 15.89 | 1743 | 2.04 | 21977 |
| | 300 | 30.32 | 2878.6 | 4546.0 | 38.58 | 11.34 | 15.64 | 1771 | 1.88 | 22728 |

* TWO PHASE BOUNDARY

TABLE VI. THERMODYNAMIC PROPERTIES OF PARAHYDROGEN

| | 600 BAR ISOBAR TEMPERATURE K | MOLAR VOLUME $CM^3/G$ | INTERNAL ENERGY J/G | ENTHALPY J/G | ENTROPY J/G-K | SPECIFIC HEAT CV J/G-K | SPECIFIC HEAT CP J/G-K | VELOCITY OF SOUND M/S | $\left(\frac{\partial P}{\partial T}\right)_V$ BAR/K | $\left(\frac{\partial P}{\partial \rho}\right)_T$ BAR-$CM^3/G$ |
|---|---|---|---|---|---|---|---|---|---|---|
| * | 27.559 | 10.47 | -232.7 | 395.7 | 5.91 | 6.09 | 7.51 | 2193 | 13.60 | 38892 |
| | 28 | 10.49 | -230.4 | 399.1 | 6.03 | 6.12 | 7.59 | 2191 | 13.57 | 38745 |
| | 29 | 10.53 | -225.1 | 405.7 | 6.30 | 6.22 | 7.75 | 2187 | 13.51 | 38407 |
| | 30 | 10.57 | -219.6 | 414.6 | 6.56 | 6.31 | 7.90 | 2183 | 13.45 | 38062 |
| | 31 | 10.61 | -214.0 | 422.5 | 6.83 | 6.39 | 8.05 | 2179 | 13.38 | 37712 |
| | 32 | 10.65 | -208.3 | 430.7 | 7.08 | 6.49 | 8.20 | 2174 | 13.31 | 37358 |
| | 33 | 10.69 | -202.5 | 438.9 | 7.34 | 6.55 | 8.34 | 2170 | 13.23 | 36999 |
| | 34 | 10.73 | -196.5 | 447.3 | 7.59 | 6.63 | 8.47 | 2165 | 13.15 | 36637 |
| | 35 | 10.77 | -190.5 | 455.9 | 7.84 | 6.69 | 8.61 | 2159 | 13.07 | 36271 |
| | 36 | 10.81 | -184.3 | 464.6 | 8.08 | 6.76 | 8.74 | 2154 | 12.98 | 35903 |
| | 37 | 10.86 | -178.1 | 473.4 | 8.32 | 6.82 | 8.86 | 2149 | 12.90 | 35534 |
| | 38 | 10.90 | -171.7 | 482.3 | 8.56 | 6.89 | 8.98 | 2143 | 12.81 | 35163 |
| | 39 | 10.94 | -165.3 | 491.3 | 8.79 | 6.92 | 9.10 | 2138 | 12.72 | 34792 |
| | 40 | 10.99 | -158.8 | 500.5 | 9.03 | 6.97 | 9.20 | 2132 | 12.62 | 34421 |
| | 42 | 11.08 | -145.6 | 519.1 | 9.48 | 7.05 | 9.42 | 2121 | 12.44 | 33680 |
| | 44 | 11.17 | -132.0 | 538.1 | 9.92 | 7.14 | 9.64 | 2109 | 12.24 | 32946 |
| | 46 | 11.26 | -118.6 | 557.1 | 10.34 | 7.25 | 9.88 | 2095 | 12.05 | 32223 |
| | 48 | 11.36 | -104.4 | 577.1 | 10.77 | 7.35 | 10.11 | 2082 | 11.85 | 31514 |
| | 50 | 11.46 | -89.8 | 597.6 | 11.19 | 7.44 | 10.33 | 2068 | 11.64 | 30824 |
| | 55 | 11.71 | -52.2 | 650.5 | 12.20 | 7.64 | 10.84 | 2035 | 11.13 | 29206 |
| | 60 | 11.98 | -12.6 | 706.2 | 13.16 | 7.81 | 11.29 | 2004 | 10.60 | 27776 |
| | 65 | 12.26 | 28.2 | 763.7 | 14.09 | 7.99 | 11.72 | 1974 | 10.07 | 26571 |
| | 70 | 12.54 | 73.5 | 823.1 | 14.97 | 8.21 | 12.13 | 1954 | 9.58 | 25873 |
| | 75 | 12.84 | 114.5 | 884.9 | 15.82 | 8.43 | 12.56 | 1927 | 9.09 | 25086 |
| | 80 | 13.14 | 160.2 | 948.8 | 16.64 | 8.80 | 12.99 | 1901 | 8.62 | 24476 |
| | 85 | 13.45 | 207.9 | 1014.9 | 17.44 | 9.15 | 13.46 | 1871 | 8.17 | 23786 |
| | 90 | 13.76 | 257.6 | 1083.4 | 18.23 | 9.53 | 13.94 | 1843 | 7.75 | 23207 |
| | 95 | 14.08 | 309.4 | 1154.3 | 18.99 | 9.92 | 14.42 | 1816 | 7.36 | 22692 |
| | 100 | 14.41 | 363.2 | 1227.5 | 19.74 | 10.31 | 14.88 | 1790 | 6.99 | 22211 |
| | 110 | 15.07 | 478.3 | 1382.3 | 21.22 | 11.15 | 15.81 | 1746 | 6.33 | 21499 |
| | 120 | 15.74 | 599.5 | 1544.0 | 22.63 | 11.82 | 16.53 | 1715 | 5.77 | 21023 |
| | 130 | 16.43 | 726.5 | 1712.1 | 23.97 | 12.34 | 17.11 | 1692 | 5.30 | 20644 |
| | 140 | 17.12 | 857.7 | 1885.2 | 25.25 | 12.71 | 17.51 | 1677 | 4.89 | 20413 |
| | 150 | 17.83 | 991.7 | 2061.4 | 26.47 | 12.94 | 17.73 | 1670 | 4.52 | 20339 |
| | 160 | 18.54 | 1126.8 | 2239.1 | 27.62 | 13.04 | 17.81 | 1667 | 4.20 | 20341 |
| | 170 | 19.25 | 1262.1 | 2417.0 | 28.69 | 13.04 | 17.78 | 1668 | 3.92 | 20410 |
| | 180 | 19.96 | 1396.5 | 2594.1 | 29.71 | 12.97 | 17.67 | 1672 | 3.67 | 20525 |
| | 190 | 20.67 | 1529.6 | 2769.8 | 30.66 | 12.94 | 17.50 | 1679 | 3.45 | 20687 |
| | 200 | 21.38 | 1660.8 | 2943.8 | 31.55 | 12.69 | 17.31 | 1687 | 3.25 | 20867 |
| | 220 | 22.81 | 1917.4 | 3285.8 | 33.18 | 12.35 | 16.90 | 1708 | 2.91 | 21324 |
| | 240 | 24.22 | 2166.1 | 3619.6 | 34.63 | 12.03 | 16.52 | 1731 | 2.64 | 21832 |
| | 260 | 25.64 | 2407.9 | 3946.4 | 35.94 | 11.76 | 16.20 | 1756 | 2.41 | 22400 |
| | 280 | 27.05 | 2644.1 | 4267.3 | 37.13 | 11.55 | 15.92 | 1783 | 2.22 | 23046 |
| | 300 | 28.46 | 2875.7 | 4583.3 | 38.22 | 11.39 | 15.69 | 1809 | 2.05 | 23751 |

* TWO PHASE BOUNDARY

TABLE VI. THERMODYNAMIC PROPERTIES OF PARAHYDROGEN

| 650 BAR ISOBAR TEMPERATURE K | MOLAR VOLUME CM3/G | INTERNAL ENERGY J/G | ENTHALPY J/G | ENTROPY J/G-K | SPECIFIC HEAT CV J/G-K | SPECIFIC HEAT CP J/G-K | VELOCITY OF SOUND M/S | $\left(\frac{\partial P}{\partial T}\right)_V$ BAR/K | $\left(\frac{\partial P}{\partial \rho}\right)_T$ BAR-CM3/G |
|---|---|---|---|---|---|---|---|---|---|
| * 28.449 | 10.37 | -224.8 | 449.3 | 5.96 | 6.15 | 7.60 | 2245 | 13.89 | 40792 |
| 29 | 10.39 | -221.9 | 453.5 | 6.11 | 6.21 | 7.69 | 2243 | 13.86 | 40613 |
| 30 | 10.43 | -216.6 | 461.3 | 6.37 | 6.30 | 7.84 | 2239 | 13.79 | 40285 |
| 31 | 10.47 | -211.1 | 469.2 | 6.63 | 6.39 | 7.99 | 2235 | 13.72 | 39949 |
| 32 | 10.50 | -205.5 | 477.3 | 6.89 | 6.47 | 8.13 | 2231 | 13.64 | 39609 |
| 33 | 10.54 | -199.8 | 485.5 | 7.14 | 6.55 | 8.27 | 2226 | 13.56 | 39263 |
| 34 | 10.58 | -193.9 | 493.8 | 7.39 | 6.62 | 8.40 | 2221 | 13.48 | 38913 |
| 35 | 10.62 | -188.0 | 502.3 | 7.63 | 6.69 | 8.53 | 2217 | 13.40 | 38559 |
| 36 | 10.66 | -182.0 | 510.9 | 7.88 | 6.76 | 8.66 | 2212 | 13.31 | 38201 |
| 37 | 10.70 | -175.8 | 519.6 | 8.11 | 6.82 | 8.78 | 2206 | 13.22 | 37841 |
| 38 | 10.74 | -169.6 | 528.4 | 8.35 | 6.88 | 8.90 | 2201 | 13.13 | 37479 |
| 39 | 10.78 | -163.3 | 537.4 | 8.58 | 6.93 | 9.01 | 2196 | 13.04 | 37115 |
| 40 | 10.82 | -156.9 | 546.4 | 8.81 | 6.98 | 9.11 | 2191 | 12.94 | 36750 |
| 42 | 10.90 | -143.9 | 564.9 | 9.26 | 7.07 | 9.32 | 2180 | 12.75 | 36020 |
| 44 | 10.99 | -130.6 | 583.7 | 9.70 | 7.15 | 9.53 | 2168 | 12.56 | 35291 |
| 46 | 11.08 | -117.5 | 602.5 | 10.12 | 7.27 | 9.77 | 2155 | 12.37 | 34569 |
| 48 | 11.16 | -103.5 | 622.2 | 10.54 | 7.37 | 9.99 | 2142 | 12.17 | 33856 |
| 50 | 11.26 | -89.2 | 642.4 | 10.95 | 7.47 | 10.20 | 2129 | 11.97 | 33158 |
| 55 | 11.49 | -52.1 | 694.7 | 11.95 | 7.69 | 10.71 | 2096 | 11.47 | 31495 |
| 60 | 11.74 | -13.2 | 749.7 | 12.90 | 7.85 | 11.16 | 2064 | 10.96 | 29988 |
| 65 | 11.99 | 27.0 | 806.6 | 13.81 | 8.04 | 11.59 | 2033 | 10.44 | 28677 |
| 70 | 12.26 | 68.8 | 865.6 | 14.69 | 8.27 | 12.03 | 2003 | 9.92 | 27581 |
| 75 | 12.53 | 112.2 | 926.8 | 15.53 | 8.54 | 12.46 | 1984 | 9.48 | 26987 |
| 80 | 12.81 | 157.6 | 990.2 | 16.35 | 8.86 | 12.92 | 1956 | 9.01 | 26253 |
| 85 | 13.09 | 204.8 | 1055.9 | 17.15 | 9.21 | 13.36 | 1932 | 8.56 | 25729 |
| 90 | 13.38 | 254.3 | 1124.0 | 17.92 | 9.59 | 13.84 | 1904 | 8.14 | 25107 |
| 95 | 13.67 | 305.6 | 1194.4 | 18.69 | 9.98 | 14.33 | 1877 | 7.75 | 24553 |
| 100 | 13.97 | 359.1 | 1267.2 | 19.43 | 10.38 | 14.80 | 1853 | 7.38 | 24089 |
| 110 | 14.58 | 473.8 | 1421.3 | 20.90 | 11.23 | 15.74 | 1807 | 6.71 | 23296 |
| 120 | 15.19 | 594.7 | 1582.2 | 22.30 | 11.89 | 16.46 | 1773 | 6.12 | 22699 |
| 130 | 15.82 | 721.3 | 1749.7 | 23.64 | 12.41 | 17.04 | 1747 | 5.63 | 22236 |
| 140 | 16.46 | 852.3 | 1922.1 | 24.92 | 12.78 | 17.45 | 1732 | 5.20 | 21955 |
| 150 | 17.10 | 986.1 | 2097.9 | 26.13 | 13.00 | 17.70 | 1722 | 4.83 | 21782 |
| 160 | 17.76 | 1121.3 | 2275.4 | 27.28 | 13.10 | 17.79 | 1719 | 4.50 | 21757 |
| 170 | 18.41 | 1256.6 | 2453.1 | 28.35 | 13.10 | 17.77 | 1719 | 4.20 | 21786 |
| 180 | 19.06 | 1391.2 | 2630.4 | 29.37 | 13.02 | 17.66 | 1722 | 3.94 | 21877 |
| 190 | 19.72 | 1524.4 | 2805.9 | 30.31 | 12.90 | 17.50 | 1728 | 3.70 | 21999 |
| 200 | 20.37 | 1655.9 | 2979.9 | 31.21 | 12.75 | 17.32 | 1734 | 3.49 | 22141 |
| 220 | 21.68 | 1912.9 | 3322.0 | 32.84 | 12.40 | 16.91 | 1753 | 3.13 | 22548 |
| 240 | 22.98 | 2162.1 | 3656.0 | 34.29 | 12.08 | 16.52 | 1774 | 2.84 | 23020 |
| 260 | 24.29 | 2404.4 | 3983.0 | 35.60 | 11.81 | 16.20 | 1797 | 2.60 | 23534 |
| 280 | 25.59 | 2641.1 | 4304.1 | 36.79 | 11.60 | 15.95 | 1821 | 2.39 | 24118 |
| 300 | 26.88 | 2873.3 | 4620.7 | 37.88 | 11.44 | 15.73 | 1846 | 2.22 | 24776 |

* TWO PHASE BOUNDARY

TABLE VI. THERMODYNAMIC PROPERTIES OF PARAHYDROGEN

| | 700 BAR ISOBAR TEMPERATURE K | MOLAR VOLUME CM3/G | INTERNAL ENERGY J/G | ENTHALPY J/G | ENTROPY J/G-K | SPECIFIC HEAT CV J/G-K | SPECIFIC HEAT CP J/G-K | VELOCITY OF SOUND M/S | $\left(\frac{\partial P}{\partial T}\right)_V$ BAR/K | $\left(\frac{\partial P}{\partial \rho}\right)_T$ BAR-CM3/G |
|---|---|---|---|---|---|---|---|---|---|---|
| * | 29.318 | 10.27 | -216.8 | 502.4 | 6.01 | 6.22 | 7.68 | 2295 | 14.18 | 42668 |
| | 30 | 10.30 | -213.2 | 507.7 | 6.19 | 6.29 | 7.78 | 2292 | 14.13 | 42454 |
| | 31 | 10.33 | -207.9 | 515.5 | 6.45 | 6.39 | 7.93 | 2289 | 14.05 | 42133 |
| | 32 | 10.37 | -202.4 | 523.5 | 6.70 | 6.47 | 8.07 | 2285 | 13.97 | 41807 |
| | 33 | 10.41 | -196.8 | 531.7 | 6.95 | 6.55 | 8.21 | 2280 | 13.89 | 41474 |
| | 34 | 10.44 | -191.0 | 540.0 | 7.20 | 6.62 | 8.34 | 2276 | 13.81 | 41137 |
| | 35 | 10.48 | -185.2 | 548.4 | 7.44 | 6.69 | 8.47 | 2271 | 13.72 | 40794 |
| | 36 | 10.52 | -179.3 | 556.9 | 7.68 | 6.76 | 8.59 | 2267 | 13.63 | 40448 |
| | 37 | 10.55 | -173.2 | 565.5 | 7.92 | 6.83 | 8.71 | 2262 | 13.54 | 40098 |
| | 38 | 10.59 | -167.1 | 574.3 | 8.15 | 6.89 | 8.82 | 2257 | 13.44 | 39745 |
| | 39 | 10.63 | -160.9 | 583.2 | 8.39 | 6.94 | 8.93 | 2252 | 13.35 | 39389 |
| | 40 | 10.67 | -154.6 | 592.2 | 8.61 | 6.99 | 9.03 | 2247 | 13.26 | 39032 |
| | 42 | 10.75 | -141.8 | 610.4 | 9.06 | 7.08 | 9.24 | 2236 | 13.06 | 38313 |
| | 44 | 10.83 | -128.7 | 629.1 | 9.49 | 7.17 | 9.44 | 2225 | 12.87 | 37592 |
| | 46 | 10.91 | -115.8 | 647.7 | 9.91 | 7.29 | 9.67 | 2212 | 12.67 | 36874 |
| | 48 | 10.99 | -102.0 | 667.3 | 10.32 | 7.39 | 9.89 | 2199 | 12.48 | 36162 |
| | 50 | 11.07 | -87.9 | 687.2 | 10.73 | 7.49 | 10.10 | 2186 | 12.28 | 35459 |
| | 55 | 11.29 | -51.4 | 739.0 | 11.72 | 7.71 | 10.59 | 2154 | 11.78 | 33767 |
| | 60 | 11.52 | -13.0 | 793.3 | 12.66 | 7.89 | 11.03 | 2122 | 11.28 | 32203 |
| | 65 | 11.76 | 26.7 | 849.6 | 13.56 | 8.09 | 11.48 | 2091 | 10.78 | 30808 |
| | 70 | 12.00 | 68.0 | 908.1 | 14.43 | 8.32 | 11.92 | 2059 | 10.28 | 29606 |
| | 75 | 12.25 | 110.9 | 968.8 | 15.27 | 8.60 | 12.36 | 2028 | 9.78 | 28609 |
| | 80 | 12.51 | 155.8 | 1031.8 | 16.08 | 8.92 | 12.84 | 2011 | 9.37 | 28107 |
| | 85 | 12.78 | 202.7 | 1097.1 | 16.87 | 9.27 | 13.31 | 1982 | 8.92 | 27392 |
| | 90 | 13.05 | 251.7 | 1164.8 | 17.64 | 9.65 | 13.77 | 1958 | 8.50 | 26882 |
| | 95 | 13.32 | 302.7 | 1234.9 | 18.40 | 10.05 | 14.24 | 1934 | 8.11 | 26391 |
| | 100 | 13.59 | 356.0 | 1307.3 | 19.15 | 10.45 | 14.72 | 1909 | 7.74 | 25859 |
| | 110 | 14.15 | 470.3 | 1460.8 | 20.61 | 11.29 | 15.68 | 1865 | 7.07 | 25057 |
| | 120 | 14.72 | 590.8 | 1621.1 | 22.00 | 11.95 | 16.41 | 1830 | 6.46 | 24421 |
| | 130 | 15.30 | 717.3 | 1788.0 | 23.34 | 12.48 | 16.96 | 1802 | 5.94 | 23897 |
| | 140 | 15.88 | 848.0 | 1959.7 | 24.61 | 12.85 | 17.40 | 1781 | 5.50 | 23431 |
| | 150 | 16.48 | 981.6 | 2135.0 | 25.82 | 13.06 | 17.66 | 1772 | 5.12 | 23235 |
| | 160 | 17.08 | 1116.7 | 2312.2 | 26.96 | 13.16 | 17.78 | 1766 | 4.78 | 23088 |
| | 170 | 17.69 | 1252.0 | 2490.0 | 28.04 | 13.16 | 17.76 | 1767 | 4.47 | 23148 |
| | 180 | 18.29 | 1386.7 | 2667.1 | 29.05 | 13.08 | 17.66 | 1770 | 4.20 | 23222 |
| | 190 | 18.89 | 1520.1 | 2842.6 | 30.00 | 12.96 | 17.50 | 1775 | 3.95 | 23321 |
| | 200 | 19.50 | 1651.7 | 3016.6 | 30.89 | 12.80 | 17.32 | 1780 | 3.73 | 23432 |
| | 220 | 20.71 | 1909.2 | 3358.8 | 32.52 | 12.46 | 16.92 | 1796 | 3.35 | 23769 |
| | 240 | 21.92 | 2158.8 | 3692.9 | 33.98 | 12.13 | 16.53 | 1816 | 3.04 | 24200 |
| | 260 | 23.12 | 2401.6 | 4020.1 | 35.29 | 11.86 | 16.21 | 1837 | 2.78 | 24683 |
| | 280 | 24.32 | 2638.7 | 4341.4 | 36.48 | 11.65 | 15.96 | 1858 | 2.56 | 25198 |
| | 300 | 25.52 | 2871.5 | 4658.2 | 37.57 | 11.49 | 15.75 | 1881 | 2.37 | 25801 |

* TWO PHASE BOUNDARY

TABLE VI. THERMODYNAMIC PROPERTIES OF PARAHYDROGEN

750 BAR ISOBAR

| | TEMPERATURE K | MOLAR VOLUME CM3/G | INTERNAL ENERGY J/G | ENTHALPY J/G | ENTROPY J/G-K | SPECIFIC HEAT CV J/G-K | SPECIFIC HEAT CP J/G-K | VELOCITY OF SOUND M/S | $\left(\frac{\partial P}{\partial T}\right)_V$ BAR/K | $\left(\frac{\partial P}{\partial \rho}\right)_T$ BAR-CM3/G |
|---|---|---|---|---|---|---|---|---|---|---|
| * | 30.168 | 10.18 | -208.8 | 555.0 | 6.06 | 6.30 | 7.77 | 2343 | 14.46 | 44524 |
| | 31 | 10.21 | -204.4 | 561.5 | 6.27 | 6.37 | 7.89 | 2340 | 14.39 | 44269 |
| | 32 | 10.25 | -199.0 | 569.5 | 6.53 | 6.46 | 8.03 | 2336 | 14.31 | 43956 |
| | 33 | 10.28 | -193.5 | 577.6 | 6.78 | 6.54 | 8.16 | 2333 | 14.22 | 43637 |
| | 34 | 10.32 | -187.8 | 585.8 | 7.02 | 6.62 | 8.29 | 2328 | 14.13 | 43312 |
| | 35 | 10.35 | -182.1 | 594.1 | 7.26 | 6.69 | 8.41 | 2324 | 14.04 | 42982 |
| | 36 | 10.39 | -176.3 | 602.6 | 7.50 | 6.76 | 8.54 | 2319 | 13.95 | 42646 |
| | 37 | 10.42 | -170.3 | 611.2 | 7.74 | 6.83 | 8.65 | 2315 | 13.85 | 42307 |
| | 38 | 10.46 | -164.3 | 619.9 | 7.97 | 6.89 | 8.76 | 2310 | 13.75 | 41963 |
| | 39 | 10.49 | -158.2 | 628.7 | 8.20 | 6.94 | 8.87 | 2305 | 13.66 | 41616 |
| | 40 | 10.53 | -152.0 | 637.7 | 8.43 | 6.99 | 8.97 | 2300 | 13.56 | 41267 |
| | 42 | 10.60 | -139.4 | 655.8 | 8.87 | 7.09 | 9.17 | 2290 | 13.36 | 40562 |
| | 44 | 10.68 | -126.4 | 674.3 | 9.30 | 7.18 | 9.36 | 2279 | 13.17 | 39851 |
| | 46 | 10.75 | -113.7 | 692.7 | 9.71 | 7.31 | 9.59 | 2267 | 12.97 | 39140 |
| | 48 | 10.83 | -100.1 | 712.1 | 10.12 | 7.41 | 9.80 | 2254 | 12.77 | 38431 |
| | 50 | 10.91 | -86.2 | 731.9 | 10.52 | 7.51 | 10.00 | 2241 | 12.57 | 37727 |
| | 55 | 11.11 | -50.2 | 783.2 | 11.50 | 7.74 | 10.49 | 2209 | 12.08 | 36017 |
| | 60 | 11.32 | -12.2 | 837.0 | 12.44 | 7.92 | 10.92 | 2178 | 11.58 | 34411 |
| | 65 | 11.54 | 27.0 | 892.7 | 13.33 | 8.13 | 11.36 | 2146 | 11.09 | 32949 |
| | 70 | 11.77 | 67.8 | 950.6 | 14.19 | 8.38 | 11.82 | 2113 | 10.60 | 31660 |
| | 75 | 12.01 | 110.4 | 1010.9 | 15.02 | 8.65 | 12.28 | 2081 | 10.11 | 30561 |
| | 80 | 12.25 | 154.8 | 1073.4 | 15.83 | 8.98 | 12.73 | 2050 | 9.63 | 29652 |
| | 85 | 12.50 | 201.3 | 1138.5 | 16.61 | 9.33 | 13.24 | 2036 | 9.27 | 29222 |
| | 90 | 12.75 | 250.0 | 1205.9 | 17.38 | 9.72 | 13.72 | 2006 | 8.84 | 28502 |
| | 95 | 13.00 | 300.8 | 1275.6 | 18.14 | 10.11 | 14.19 | 1984 | 8.44 | 28054 |
| | 100 | 13.25 | 353.8 | 1347.8 | 18.88 | 10.51 | 14.65 | 1962 | 8.07 | 27636 |
| | 110 | 13.77 | 467.6 | 1500.5 | 20.33 | 11.36 | 15.63 | 1917 | 7.39 | 26711 |
| | 120 | 14.30 | 587.9 | 1660.5 | 21.73 | 12.03 | 16.36 | 1885 | 6.79 | 26127 |
| | 130 | 14.84 | 714.2 | 1827.0 | 23.06 | 12.55 | 16.92 | 1856 | 6.25 | 25555 |
| | 140 | 15.38 | 844.8 | 1998.1 | 24.32 | 12.92 | 17.32 | 1833 | 5.77 | 25082 |
| | 150 | 15.93 | 978.1 | 2172.6 | 25.53 | 13.13 | 17.61 | 1816 | 5.38 | 24582 |
| | 160 | 16.49 | 1113.1 | 2349.6 | 26.67 | 13.23 | 17.74 | 1812 | 5.04 | 24476 |
| | 170 | 17.05 | 1248.4 | 2527.0 | 27.75 | 13.22 | 17.76 | 1808 | 4.73 | 24341 |
| | 180 | 17.62 | 1383.1 | 2704.2 | 28.76 | 13.14 | 17.66 | 1814 | 4.45 | 24499 |
| | 190 | 18.18 | 1516.6 | 2879.8 | 29.71 | 13.02 | 17.50 | 1819 | 4.19 | 24627 |
| | 200 | 18.74 | 1648.4 | 3053.9 | 30.60 | 12.86 | 17.32 | 1824 | 3.96 | 24729 |
| | 220 | 19.86 | 1906.2 | 3396.0 | 32.23 | 12.52 | 16.92 | 1837 | 3.56 | 24974 |
| | 240 | 20.99 | 2156.3 | 3730.3 | 33.69 | 12.19 | 16.54 | 1855 | 3.23 | 25372 |
| | 260 | 22.11 | 2399.5 | 4057.6 | 35.00 | 11.91 | 16.22 | 1875 | 2.96 | 25825 |
| | 280 | 23.23 | 2637.1 | 4379.1 | 36.19 | 11.70 | 15.96 | 1895 | 2.73 | 26321 |
| | 300 | 24.34 | 2870.3 | 4696.1 | 37.28 | 11.54 | 15.77 | 1915 | 2.53 | 26825 |

* TWO PHASE BOUNDARY

TABLE VI. THERMODYNAMIC PROPERTIES OF PARAHYDROGEN

| | 800 BAR ISOBAR TEMPERATURE K | MOLAR VOLUME CM3/G | INTERNAL ENERGY J/G | ENTHALPY J/G | ENTROPY J/G-K | SPECIFIC HEAT CV J/G-K | SPECIFIC HEAT CP J/G-K | VELOCITY OF SOUND M/S | $\left(\frac{\partial P}{\partial T}\right)_V$ BAR/K | $\left(\frac{\partial P}{\partial \rho}\right)_T$ BAR-CM3/G |
|---|---|---|---|---|---|---|---|---|---|---|
| * | 30.999 | 10.10 | -200.7 | 607.2 | 6.11 | 6.37 | 7.85 | 2390 | 14.73 | 46360 |
| | 31 | 10.10 | -200.7 | 607.2 | 6.11 | 6.37 | 7.85 | 2390 | 14.73 | 46360 |
| | 32 | 10.13 | -195.4 | 615.1 | 6.36 | 6.46 | 7.99 | 2387 | 14.64 | 46062 |
| | 33 | 10.16 | -190.0 | 623.1 | 6.61 | 6.54 | 8.12 | 2383 | 14.55 | 45756 |
| | 34 | 10.20 | -184.4 | 631.3 | 6.85 | 6.62 | 8.25 | 2379 | 14.45 | 45443 |
| | 35 | 10.23 | -178.8 | 639.6 | 7.09 | 6.70 | 8.37 | 2375 | 14.36 | 45125 |
| | 36 | 10.26 | -173.0 | 648.0 | 7.33 | 6.77 | 8.49 | 2370 | 14.26 | 44801 |
| | 37 | 10.30 | -167.2 | 656.6 | 7.56 | 6.84 | 8.60 | 2366 | 14.16 | 44472 |
| | 38 | 10.33 | -161.2 | 665.3 | 7.80 | 6.90 | 8.71 | 2361 | 14.06 | 44138 |
| | 39 | 10.36 | -155.2 | 674.0 | 8.02 | 6.95 | 8.82 | 2357 | 13.96 | 43800 |
| | 40 | 10.40 | -149.1 | 682.9 | 8.25 | 7.00 | 8.91 | 2352 | 13.86 | 43459 |
| | 42 | 10.47 | -136.6 | 700.9 | 8.69 | 7.10 | 9.11 | 2342 | 13.66 | 42769 |
| | 44 | 10.54 | -123.8 | 719.3 | 9.12 | 7.19 | 9.30 | 2332 | 13.46 | 42070 |
| | 46 | 10.61 | -111.3 | 737.6 | 9.52 | 7.32 | 9.52 | 2319 | 13.25 | 41367 |
| | 48 | 10.68 | -97.8 | 756.8 | 9.93 | 7.43 | 9.73 | 2307 | 13.05 | 40663 |
| | 50 | 10.76 | -84.1 | 776.5 | 10.33 | 7.53 | 9.92 | 2294 | 12.85 | 39962 |
| | 55 | 10.95 | -48.5 | 827.3 | 11.30 | 7.76 | 10.39 | 2263 | 12.36 | 38241 |
| | 60 | 11.14 | -11.0 | 880.6 | 12.23 | 7.96 | 10.82 | 2231 | 11.87 | 36603 |
| | 65 | 11.35 | 27.8 | 935.8 | 13.11 | 8.17 | 11.26 | 2199 | 11.38 | 35088 |
| | 70 | 11.56 | 68.3 | 993.3 | 13.96 | 8.42 | 11.72 | 2166 | 10.90 | 33728 |
| | 75 | 11.78 | 110.5 | 1053.1 | 14.79 | 8.71 | 12.19 | 2133 | 10.42 | 32542 |
| | 80 | 12.01 | 154.6 | 1115.2 | 15.59 | 9.04 | 12.66 | 2101 | 9.95 | 31537 |
| | 85 | 12.24 | 200.8 | 1179.7 | 16.37 | 9.40 | 13.13 | 2070 | 9.48 | 30708 |
| | 90 | 12.48 | 249.0 | 1247.1 | 17.14 | 9.78 | 13.66 | 2058 | 9.17 | 30330 |
| | 95 | 12.71 | 299.6 | 1316.4 | 17.89 | 10.13 | 14.13 | 2033 | 8.75 | 29772 |
| | 100 | 12.95 | 352.3 | 1388.4 | 18.63 | 10.58 | 14.60 | 2008 | 8.37 | 29215 |
| | 110 | 13.44 | 465.7 | 1540.7 | 20.08 | 11.43 | 15.58 | 1964 | 7.69 | 28313 |
| | 120 | 13.93 | 585.7 | 1700.1 | 21.47 | 12.10 | 16.34 | 1932 | 7.10 | 27648 |
| | 130 | 14.43 | 711.9 | 1866.4 | 22.80 | 12.62 | 16.89 | 1908 | 6.55 | 27217 |
| | 140 | 14.93 | 842.4 | 2037.1 | 24.06 | 12.99 | 17.28 | 1885 | 6.05 | 26716 |
| | 150 | 15.44 | 975.7 | 2211.0 | 25.26 | 13.21 | 17.53 | 1864 | 5.62 | 26197 |
| | 160 | 15.96 | 1110.4 | 2387.2 | 26.40 | 13.29 | 17.71 | 1849 | 5.27 | 25677 |
| | 170 | 16.49 | 1245.6 | 2564.6 | 27.48 | 13.29 | 17.72 | 1851 | 4.97 | 25679 |
| | 180 | 17.01 | 1380.3 | 2741.4 | 28.49 | 13.21 | 17.68 | 1849 | 4.68 | 25529 |
| | 190 | 17.54 | 1513.8 | 2917.2 | 29.44 | 13.08 | 17.51 | 1859 | 4.42 | 25819 |
| | 200 | 18.07 | 1645.7 | 3091.4 | 30.33 | 12.92 | 17.32 | 1866 | 4.18 | 25996 |
| | 220 | 19.12 | 1903.9 | 3433.6 | 31.96 | 12.58 | 16.93 | 1878 | 3.76 | 26206 |
| | 240 | 20.17 | 2154.4 | 3768.3 | 33.42 | 12.25 | 16.55 | 1893 | 3.42 | 26521 |
| | 260 | 21.22 | 2398.0 | 4095.6 | 34.73 | 11.97 | 16.23 | 1912 | 3.13 | 26958 |
| | 280 | 22.26 | 2636.0 | 4417.2 | 35.92 | 11.75 | 15.97 | 1930 | 2.89 | 27422 |
| | 300 | 23.31 | 2869.7 | 4734.3 | 37.01 | 11.59 | 15.77 | 1949 | 2.68 | 27920 |

* TWO PHASE BOUNDARY

TABLE VI. THERMODYNAMIC PROPERTIES OF PARAHYDROGEN

| 850 BAR ISOBAR TEMPERATURE K | MOLAR VOLUME $CM^3/G$ | INTERNAL ENERGY J/G | ENTHALPY J/G | ENTROPY J/G-K | SPECIFIC HEAT CV J/G-K | SPECIFIC HEAT CP J/G-K | VELOCITY OF SOUND M/S | $\left(\frac{\partial P}{\partial T}\right)_V$ BAR/K | $\left(\frac{\partial P}{\partial \rho}\right)_T$ BAR-$CM^3$/G |
|---|---|---|---|---|---|---|---|---|---|
| * 31.814 | 10.02 | -192.6 | 658.9 | 6.15 | 6.44 | 7.93 | 2435 | 14.99 | 48179 |
| 32 | 10.02 | -191.6 | 660.3 | 6.20 | 6.46 | 7.95 | 2435 | 14.98 | 48126 |
| 33 | 10.05 | -186.3 | 658.4 | 6.45 | 6.54 | 8.09 | 2431 | 14.88 | 47833 |
| 34 | 10.09 | -180.8 | 676.5 | 6.69 | 6.62 | 8.21 | 2428 | 14.78 | 47533 |
| 35 | 10.12 | -175.2 | 684.8 | 6.93 | 6.70 | 8.33 | 2424 | 14.68 | 47227 |
| 36 | 10.15 | -169.5 | 693.2 | 7.17 | 6.77 | 8.45 | 2419 | 14.57 | 46914 |
| 37 | 10.18 | -163.8 | 701.7 | 7.40 | 6.84 | 8.56 | 2415 | 14.47 | 46596 |
| 38 | 10.21 | -157.9 | 710.3 | 7.63 | 6.90 | 8.67 | 2411 | 14.37 | 46272 |
| 39 | 10.25 | -151.9 | 719.0 | 7.86 | 6.96 | 8.77 | 2406 | 14.26 | 45944 |
| 40 | 10.28 | -145.9 | 727.9 | 8.08 | 7.01 | 8.87 | 2402 | 14.16 | 45612 |
| 42 | 10.35 | -133.6 | 745.8 | 8.52 | 7.11 | 9.06 | 2392 | 13.95 | 44936 |
| 44 | 10.41 | -121.0 | 764.1 | 8.94 | 7.21 | 9.24 | 2382 | 13.74 | 44250 |
| 46 | 10.48 | -108.5 | 782.2 | 9.35 | 7.34 | 9.46 | 2370 | 13.53 | 43557 |
| 48 | 10.55 | -95.3 | 801.4 | 9.75 | 7.45 | 9.66 | 2358 | 13.33 | 42860 |
| 50 | 10.62 | -81.7 | 820.9 | 10.15 | 7.55 | 9.86 | 2345 | 13.12 | 42163 |
| 55 | 10.80 | -46.4 | 871.3 | 11.11 | 7.79 | 10.32 | 2314 | 12.63 | 40438 |
| 60 | 10.98 | -9.3 | 924.2 | 12.03 | 7.99 | 10.74 | 2283 | 12.14 | 38777 |
| 65 | 11.17 | 29.2 | 979.0 | 12.91 | 8.21 | 11.17 | 2251 | 11.66 | 37220 |
| 70 | 11.37 | 69.3 | 1036.0 | 13.75 | 8.47 | 11.63 | 2217 | 11.18 | 35799 |
| 75 | 11.58 | 111.2 | 1095.3 | 14.57 | 8.76 | 12.11 | 2184 | 10.71 | 34537 |
| 80 | 11.79 | 155.0 | 1157.1 | 15.37 | 9.10 | 12.59 | 2151 | 10.25 | 33448 |
| 85 | 12.00 | 200.9 | 1221.2 | 16.15 | 9.47 | 13.07 | 2119 | 9.79 | 32531 |
| 90 | 12.22 | 248.9 | 1287.8 | 16.91 | 9.85 | 13.54 | 2089 | 9.33 | 31774 |
| 95 | 12.45 | 299.0 | 1357.5 | 17.66 | 10.24 | 14.10 | 2079 | 9.07 | 31425 |
| 100 | 12.68 | 351.6 | 1429.1 | 18.40 | 10.65 | 14.54 | 2057 | 8.67 | 30983 |
| 110 | 13.13 | 464.6 | 1580.8 | 19.84 | 11.50 | 15.54 | 2005 | 7.96 | 29746 |
| 120 | 13.60 | 584.3 | 1740.1 | 21.23 | 12.16 | 16.31 | 1973 | 7.36 | 29043 |
| 130 | 14.07 | 710.2 | 1906.0 | 22.55 | 12.69 | 16.89 | 1951 | 6.83 | 28600 |
| 140 | 14.54 | 840.8 | 2076.5 | 23.82 | 13.06 | 17.25 | 1935 | 6.33 | 28346 |
| 150 | 15.01 | 974.1 | 2250.1 | 25.02 | 13.28 | 17.48 | 1915 | 5.88 | 27861 |
| 160 | 15.49 | 1108.7 | 2425.7 | 26.15 | 13.37 | 17.62 | 1894 | 5.49 | 27222 |
| 170 | 15.98 | 1243.7 | 2602.1 | 27.22 | 13.36 | 17.71 | 1882 | 5.18 | 26719 |
| 180 | 16.48 | 1378.3 | 2779.1 | 28.23 | 13.27 | 17.64 | 1888 | 4.89 | 26834 |
| 190 | 16.97 | 1511.8 | 2954.3 | 29.18 | 13.14 | 17.55 | 1887 | 4.64 | 26649 |
| 200 | 17.47 | 1643.8 | 3129.1 | 30.07 | 12.98 | 17.34 | 1902 | 4.40 | 27089 |
| 220 | 18.46 | 1902.2 | 3471.5 | 31.71 | 12.63 | 16.94 | 1916 | 3.96 | 27386 |
| 240 | 19.45 | 2153.1 | 3806.0 | 33.16 | 12.30 | 16.55 | 1931 | 3.60 | 27708 |
| 260 | 20.43 | 2397.1 | 4133.7 | 34.47 | 12.02 | 16.24 | 1946 | 3.30 | 28038 |
| 280 | 21.41 | 2635.6 | 4455.5 | 35.67 | 11.81 | 15.97 | 1964 | 3.04 | 28510 |
| 300 | 22.39 | 2869.7 | 4772.7 | 36.76 | 11.64 | 15.77 | 1982 | 2.82 | 28979 |

* TWO PHASE BOUNDARY

TABLE VI. THERMODYNAMIC PROPERTIES OF PARAHYDROGEN

| 900 BAR ISOBAR TEMPERATURE K | MOLAR VOLUME CM3/G | INTERNAL ENERGY J/G | ENTHALPY J/G | ENTROPY J/G-K | SPECIFIC HEAT CV J/G-K | SPECIFIC HEAT CP J/G-K | VELOCITY OF SOUND M/S | $\left(\frac{\partial P}{\partial T}\right)_V$ BAR/K | $\left(\frac{\partial P}{\partial \rho}\right)_T$ BAR-CM3/G |
|---|---|---|---|---|---|---|---|---|---|
| * 32.614 | 9.94 | -184.4 | 710.2 | 6.20 | 6.51 | 8.01 | 2480 | 15.25 | 49981 |
| 33 | 9.95 | -182.4 | 713.3 | 6.29 | 6.54 | 8.06 | 2478 | 15.21 | 49872 |
| 34 | 9.98 | -177.0 | 721.4 | 6.54 | 6.62 | 8.18 | 2475 | 15.10 | 49585 |
| 35 | 10.01 | -171.5 | 729.7 | 6.77 | 6.70 | 8.30 | 2471 | 15.00 | 49291 |
| 36 | 10.04 | -165.9 | 738.0 | 7.01 | 6.78 | 8.42 | 2467 | 14.89 | 48989 |
| 37 | 10.07 | -160.2 | 746.5 | 7.24 | 6.85 | 8.53 | 2463 | 14.78 | 48682 |
| 38 | 10.11 | -154.4 | 755.1 | 7.47 | 6.91 | 8.64 | 2459 | 14.67 | 48368 |
| 39 | 10.14 | -148.5 | 763.8 | 7.70 | 6.97 | 8.74 | 2454 | 14.56 | 48050 |
| 40 | 10.17 | -142.5 | 772.6 | 7.92 | 7.02 | 8.83 | 2450 | 14.45 | 47726 |
| 42 | 10.23 | -130.3 | 790.4 | 8.35 | 7.12 | 9.01 | 2441 | 14.23 | 47067 |
| 44 | 10.29 | -117.8 | 808.6 | 8.78 | 7.22 | 9.20 | 2430 | 14.02 | 46394 |
| 46 | 10.36 | -105.6 | 826.7 | 9.18 | 7.35 | 9.41 | 2419 | 13.81 | 45712 |
| 48 | 10.42 | -92.4 | 845.7 | 9.58 | 7.47 | 9.61 | 2407 | 13.59 | 45023 |
| 50 | 10.49 | -78.9 | 865.1 | 9.98 | 7.57 | 9.80 | 2395 | 13.39 | 44331 |
| 55 | 10.66 | -44.0 | 915.2 | 10.94 | 7.81 | 10.25 | 2364 | 12.88 | 42607 |
| 60 | 10.83 | -7.2 | 967.8 | 11.85 | 8.02 | 10.66 | 2332 | 12.39 | 40930 |
| 65 | 11.01 | 30.9 | 1022.1 | 12.72 | 8.24 | 11.09 | 2300 | 11.91 | 39338 |
| 70 | 11.20 | 70.7 | 1078.7 | 13.56 | 8.51 | 11.55 | 2267 | 11.45 | 37866 |
| 75 | 11.39 | 112.3 | 1137.6 | 14.37 | 8.81 | 12.03 | 2233 | 10.98 | 36539 |
| 80 | 11.59 | 155.9 | 1199.0 | 15.16 | 9.15 | 12.52 | 2199 | 10.52 | 35374 |
| 85 | 11.79 | 201.6 | 1262.9 | 15.94 | 9.53 | 13.02 | 2167 | 10.07 | 34376 |
| 90 | 12.00 | 249.4 | 1329.1 | 16.70 | 9.92 | 13.50 | 2136 | 9.63 | 33540 |
| 95 | 12.20 | 299.3 | 1397.8 | 17.44 | 10.32 | 13.96 | 2108 | 9.19 | 32849 |
| 100 | 12.43 | 351.4 | 1470.0 | 18.18 | 10.71 | 14.53 | 2100 | 8.97 | 32494 |
| 110 | 12.85 | 464.2 | 1621.1 | 19.62 | 11.57 | 15.49 | 2050 | 8.23 | 31377 |
| 120 | 13.29 | 583.6 | 1779.9 | 21.00 | 12.24 | 16.24 | 2018 | 7.61 | 30692 |
| 130 | 13.73 | 709.3 | 1945.4 | 22.32 | 12.76 | 16.87 | 1989 | 7.08 | 29925 |
| 140 | 14.19 | 839.7 | 2116.4 | 23.59 | 13.13 | 17.24 | 1978 | 6.60 | 29816 |
| 150 | 14.63 | 973.1 | 2289.8 | 24.79 | 13.35 | 17.45 | 1963 | 6.13 | 29492 |
| 160 | 15.08 | 1107.8 | 2464.8 | 25.92 | 13.44 | 17.55 | 1945 | 5.72 | 28962 |
| 170 | 15.53 | 1242.7 | 2640.3 | 26.98 | 13.43 | 17.66 | 1915 | 5.37 | 27872 |
| 180 | 15.99 | 1377.1 | 2816.4 | 27.99 | 13.34 | 17.64 | 1913 | 5.08 | 27700 |
| 190 | 16.46 | 1510.5 | 2991.7 | 28.93 | 13.21 | 17.50 | 1924 | 4.83 | 27949 |
| 200 | 16.93 | 1642.5 | 3166.2 | 29.83 | 13.04 | 17.40 | 1921 | 4.59 | 27675 |
| 220 | 17.87 | 1901.2 | 3509.5 | 31.47 | 12.69 | 16.95 | 1951 | 4.16 | 28496 |
| 240 | 18.80 | 2152.4 | 3844.5 | 32.92 | 12.36 | 16.55 | 1968 | 3.78 | 28917 |
| 260 | 19.73 | 2396.8 | 4172.1 | 34.23 | 12.08 | 16.24 | 1980 | 3.46 | 29175 |
| 280 | 20.65 | 2635.7 | 4494.0 | 35.43 | 11.86 | 15.99 | 1995 | 3.20 | 29545 |
| 300 | 21.57 | 2870.2 | 4811.6 | 36.52 | 11.69 | 15.79 | 2012 | 2.97 | 29982 |

* TWO PHASE BOUNDARY

TABLE VI. THERMODYNAMIC PROPERTIES OF PARAHYDROGEN

| | 950 BAR ISOBAR TEMPERATURE K | MOLAR VOLUME $CM^3/G$ | INTERNAL ENERGY J/G | ENTHALPY J/G | ENTROPY J/G-K | SPECIFIC HEAT CV J/G-K | SPECIFIC HEAT CP J/G-K | VELOCITY OF SOUND M/S | $\left(\frac{\partial P}{\partial T}\right)_V$ BAR/K | $\left(\frac{\partial P}{\partial \rho}\right)_T$ BAR-$CM^3/G$ |
|---|---|---|---|---|---|---|---|---|---|---|
| * | 33.398 | 9.87 | -176.3 | 761.1 | 6.24 | 6.58 | 8.09 | 2523 | 15.50 | 51768 |
| | 34 | 9.88 | -173.0 | 766.0 | 6.39 | 6.63 | 8.16 | 2520 | 15.43 | 51601 |
| | 35 | 9.91 | -167.6 | 774.2 | 6.63 | 6.71 | 8.28 | 2517 | 15.32 | 51319 |
| | 36 | 9.94 | -162.1 | 782.6 | 6.86 | 6.78 | 8.40 | 2513 | 15.20 | 51029 |
| | 37 | 9.97 | -156.4 | 791.0 | 7.09 | 6.85 | 8.51 | 2509 | 15.09 | 50732 |
| | 38 | 10.00 | -150.7 | 799.6 | 7.32 | 6.92 | 8.61 | 2505 | 14.97 | 50429 |
| | 39 | 10.03 | -144.8 | 808.3 | 7.54 | 6.98 | 8.71 | 2501 | 14.86 | 50120 |
| | 40 | 10.06 | -138.9 | 817.0 | 7.77 | 7.03 | 8.80 | 2496 | 14.75 | 49806 |
| | 42 | 10.12 | -126.9 | 834.8 | 8.20 | 7.14 | 8.98 | 2487 | 14.52 | 49163 |
| | 44 | 10.18 | -114.5 | 852.9 | 8.62 | 7.24 | 9.16 | 2477 | 14.29 | 48504 |
| | 46 | 10.24 | -102.3 | 870.9 | 9.02 | 7.37 | 9.37 | 2466 | 14.07 | 47833 |
| | 48 | 10.31 | -89.3 | 889.9 | 9.42 | 7.49 | 9.56 | 2454 | 13.86 | 47153 |
| | 50 | 10.37 | -76.0 | 909.2 | 9.82 | 7.59 | 9.75 | 2442 | 13.64 | 46467 |
| | 55 | 10.53 | -41.3 | 959.0 | 10.77 | 7.94 | 10.19 | 2411 | 13.13 | 44748 |
| | 60 | 10.70 | -4.8 | 1011.2 | 11.68 | 8.05 | 10.59 | 2380 | 12.63 | 43059 |
| | 65 | 10.87 | 33.0 | 1065.2 | 12.54 | 8.23 | 11.02 | 2348 | 12.15 | 41439 |
| | 70 | 11.04 | 72.5 | 1121.4 | 13.37 | 8.55 | 11.47 | 2314 | 11.69 | 39924 |
| | 75 | 11.22 | 113.9 | 1180.0 | 14.18 | 8.86 | 11.95 | 2280 | 11.23 | 38539 |
| | 80 | 11.41 | 157.2 | 1241.0 | 14.97 | 9.21 | 12.45 | 2246 | 10.78 | 37306 |
| | 85 | 11.60 | 202.7 | 1304.5 | 15.74 | 9.58 | 12.96 | 2213 | 10.34 | 36234 |
| | 90 | 11.79 | 250.3 | 1370.6 | 16.49 | 9.93 | 13.45 | 2182 | 9.90 | 35323 |
| | 95 | 11.99 | 300.2 | 1439.0 | 17.23 | 10.39 | 13.93 | 2152 | 9.47 | 34562 |
| | 100 | 12.19 | 352.2 | 1509.8 | 17.96 | 10.79 | 14.37 | 2125 | 9.04 | 33930 |
| | 110 | 12.61 | 464.4 | 1662.0 | 19.41 | 11.64 | 15.40 | 2107 | 8.50 | 33547 |
| | 120 | 13.01 | 583.5 | 1819.7 | 20.78 | 12.31 | 16.20 | 2055 | 7.84 | 32102 |
| | 130 | 13.44 | 709.0 | 1985.3 | 22.11 | 12.83 | 16.83 | 2025 | 7.30 | 31255 |
| | 140 | 13.86 | 839.2 | 2155.7 | 23.37 | 13.20 | 17.26 | 2009 | 6.83 | 30868 |
| | 150 | 14.28 | 972.6 | 2329.5 | 24.57 | 13.42 | 17.45 | 2004 | 6.38 | 30894 |
| | 160 | 14.71 | 1107.5 | 2504.7 | 25.70 | 13.52 | 17.52 | 1992 | 5.95 | 30604 |
| | 170 | 15.13 | 1242.5 | 2679.8 | 26.76 | 13.51 | 17.53 | 1975 | 5.58 | 30068 |
| | 180 | 15.55 | 1376.9 | 2854.6 | 27.76 | 13.42 | 17.59 | 1942 | 5.25 | 28769 |
| | 190 | 15.98 | 1510.1 | 3028.4 | 28.70 | 13.28 | 17.51 | 1944 | 5.00 | 28651 |
| | 200 | 16.44 | 1642.0 | 3203.6 | 29.60 | 13.11 | 17.34 | 1958 | 4.76 | 28988 |
| | 220 | 17.33 | 1900.7 | 3546.9 | 31.24 | 12.75 | 16.99 | 1978 | 4.34 | 29384 |
| | 240 | 18.22 | 2152.2 | 3883.0 | 32.70 | 12.42 | 16.56 | 2001 | 3.95 | 30026 |
| | 260 | 19.09 | 2397.1 | 4210.9 | 34.01 | 12.14 | 16.25 | 2013 | 3.62 | 30279 |
| | 280 | 19.96 | 2636.4 | 4532.9 | 35.20 | 11.92 | 16.00 | 2026 | 3.34 | 30574 |
| | 300 | 20.83 | 2871.3 | 4850.5 | 36.30 | 11.75 | 15.80 | 2042 | 3.10 | 31005 |

* TWO PHASE BOUNDARY

TABLE VI. THERMODYNAMIC PROPERTIES OF PARAHYDROGEN

1000 BAR ISOBAR

| | TEMPERATURE K | MOLAR VOLUME $CM^3/G$ | INTERNAL ENERGY J/G | ENTHALPY J/G | ENTROPY J/G-K | SPECIFIC HEAT CV J/G-K | SPECIFIC HEAT CP J/G-K | VELOCITY OF SOUND M/S | $\left(\frac{\partial P}{\partial T}\right)_V$ BAR/K | $\left(\frac{\partial P}{\partial \rho}\right)_T$ BAR-$CM^3/G$ |
|---|---|---|---|---|---|---|---|---|---|---|
| * | 34.169 | 9.80 | -168.0 | 811.7 | 6.28 | 6.65 | 8.16 | 2564 | 15.74 | 53539 |
| | 35 | 9.82 | -163.6 | 818.5 | 6.48 | 6.71 | 8.26 | 2561 | 15.64 | 53314 |
| | 36 | 9.85 | -158.1 | 826.9 | 6.72 | 6.79 | 8.38 | 2558 | 15.52 | 53035 |
| | 37 | 9.88 | -152.5 | 835.3 | 6.95 | 6.86 | 8.49 | 2554 | 15.40 | 52749 |
| | 38 | 9.91 | -146.8 | 843.8 | 7.17 | 6.93 | 8.59 | 2550 | 15.28 | 52456 |
| | 39 | 9.94 | -141.0 | 852.5 | 7.40 | 6.99 | 8.68 | 2546 | 15.16 | 52157 |
| | 40 | 9.96 | -135.2 | 861.2 | 7.62 | 7.04 | 8.78 | 2541 | 15.04 | 51852 |
| | 42 | 10.02 | -123.2 | 878.9 | 8.05 | 7.15 | 8.95 | 2533 | 14.80 | 51225 |
| | 44 | 10.08 | -111.0 | 897.0 | 8.47 | 7.25 | 9.13 | 2523 | 14.57 | 50581 |
| | 46 | 10.14 | -98.9 | 914.9 | 8.87 | 7.39 | 9.34 | 2511 | 14.34 | 49922 |
| | 48 | 10.20 | -86.0 | 933.8 | 9.27 | 7.51 | 9.53 | 2500 | 14.11 | 49251 |
| | 50 | 10.26 | -72.7 | 953.0 | 9.66 | 7.62 | 9.71 | 2488 | 13.89 | 48573 |
| | 55 | 10.41 | -38.4 | 1002.7 | 10.61 | 7.87 | 10.14 | 2457 | 13.36 | 46862 |
| | 60 | 10.57 | -2.1 | 1054.6 | 11.51 | 8.08 | 10.53 | 2426 | 12.86 | 45165 |
| | 65 | 10.73 | 35.5 | 1108.3 | 12.37 | 8.31 | 10.95 | 2394 | 12.38 | 43523 |
| | 70 | 10.89 | 74.7 | 1164.1 | 13.20 | 8.59 | 11.40 | 2360 | 11.92 | 41969 |
| | 75 | 11.07 | 115.8 | 1222.3 | 14.00 | 8.90 | 11.88 | 2326 | 11.47 | 40534 |
| | 80 | 11.24 | 158.9 | 1283.0 | 14.79 | 9.25 | 12.39 | 2291 | 11.02 | 39238 |
| | 85 | 11.42 | 204.2 | 1346.2 | 15.55 | 9.64 | 12.90 | 2258 | 10.59 | 38097 |
| | 90 | 11.60 | 251.7 | 1412.0 | 16.31 | 10.04 | 13.41 | 2226 | 10.16 | 37114 |
| | 95 | 11.79 | 301.4 | 1480.3 | 17.04 | 10.45 | 13.90 | 2196 | 9.73 | 36284 |
| | 100 | 11.98 | 353.4 | 1550.9 | 17.77 | 10.86 | 14.36 | 2169 | 9.31 | 35592 |
| | 110 | 12.35 | 465.2 | 1700.3 | 19.19 | 11.72 | 15.23 | 2118 | 8.50 | 34527 |
| | 120 | 12.76 | 584.0 | 1860.2 | 20.58 | 12.38 | 16.20 | 2088 | 8.07 | 33349 |
| | 130 | 13.15 | 709.3 | 2024.7 | 21.90 | 12.91 | 16.84 | 2050 | 7.50 | 32233 |
| | 140 | 13.55 | 839.4 | 2194.6 | 23.16 | 13.29 | 17.25 | 2039 | 7.03 | 31990 |
| | 150 | 13.96 | 972.6 | 2368.5 | 24.36 | 13.50 | 17.50 | 2030 | 6.60 | 31779 |
| | 160 | 14.37 | 1107.6 | 2544.7 | 25.50 | 13.59 | 17.53 | 2031 | 6.18 | 31975 |
| | 170 | 14.77 | 1242.8 | 2719.9 | 26.56 | 13.59 | 17.50 | 2021 | 5.79 | 31698 |
| | 180 | 15.17 | 1377.4 | 2894.2 | 27.55 | 13.49 | 17.42 | 2005 | 5.44 | 31147 |
| | 190 | 15.57 | 1510.7 | 3067.3 | 28.49 | 13.35 | 17.47 | 1968 | 5.14 | 29608 |
| | 200 | 15.98 | 1642.4 | 3239.9 | 29.37 | 13.18 | 17.36 | 1971 | 4.91 | 29505 |
| | 220 | 16.84 | 1900.9 | 3585.1 | 31.02 | 12.82 | 17.09 | 1981 | 4.49 | 29423 |
| | 240 | 17.68 | 2152.6 | 3920.9 | 32.48 | 12.48 | 16.60 | 2025 | 4.12 | 30868 |
| | 260 | 18.52 | 2397.8 | 4249.6 | 33.80 | 12.20 | 16.26 | 2044 | 3.78 | 31326 |
| | 280 | 19.34 | 2637.5 | 4571.7 | 34.99 | 11.98 | 16.00 | 2057 | 3.49 | 31690 |
| | 300 | 20.16 | 2872.9 | 4889.2 | 36.09 | 11.81 | 15.80 | 2069 | 3.24 | 31993 |

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16. ABSTRACT *(A 200-word or less factual summary of most significant information. If document includes a significant bibliography or literature survey, mention it here.)*

NBS compressibility measurements and thermodynamic properties data for parahydrogen have been extended to higher temperatures and pressures. Results of an experimental program are presented in the form of new PVT data in the temperature range 23-300 K at pressures up to 800 bar. Also given are tables of thermodynamic properties on isobars to 1000 bar including density, internal energy, enthalpy, entropy, specific heats at constant volume and constant pressure, velocity of sound, and the surface derivatives $(\partial P/\partial T)_v$ and $(\partial P/\partial \rho)_T$. The accuracy of the data is discussed and comparisons are made with previous data.

17. KEY WORDS *(six to twelve entries; alphabetical order; capitalize only the first letter of the first key word unless a proper name; separated by semicolons)*
Density; enthalpy; entropy; hydrogen; properties of fluids; specific heat; velocity of sound.

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